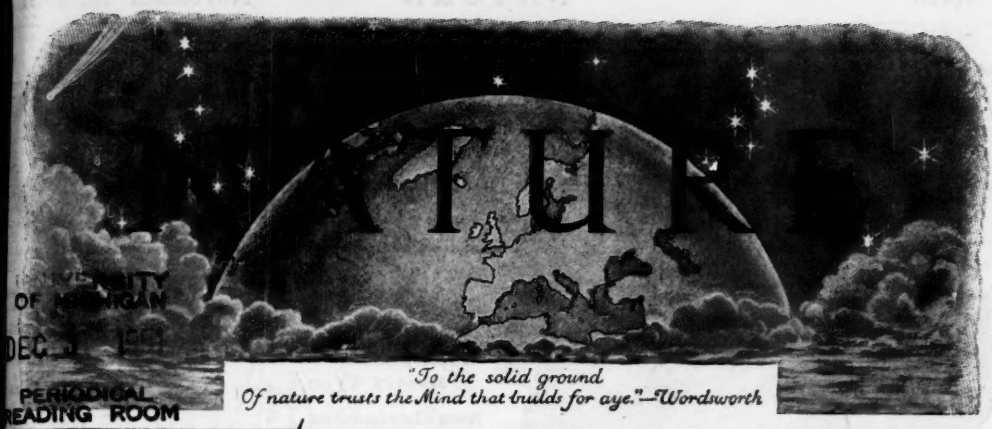

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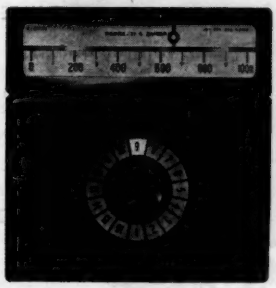

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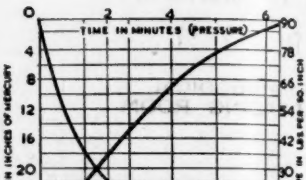

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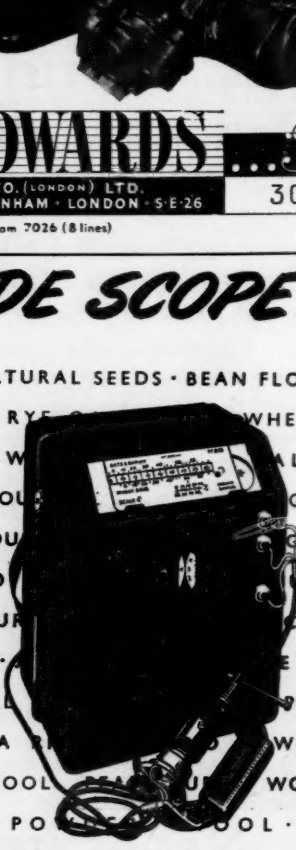

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NATURE

No. 4280 SATURDAY, NOVEMBER 10, 1951 Vol. 168

CONTENTS

	Page
International Institutions	797
Anthropology and Social Studies. By Mrs. Mary Douglas	799
Colloid Science. By Dr. A. S. C. Lawrence	800
Free-living Nematodes. By Prof. C. H. O'Donoghue	801
Recent Developments in Metal Physics. By Dr. W. Hume-Rothery, F.R.S.	801
Cancer for the Layman. By Prof. J. S. Mitchell	802
Agricultural Research in the Groundnut Scheme, 1947-51. By Dr. A. H. Bunting	804
Eighth International Congress of Refrigeration. By Dr. G. G. Haselden	806
Low-Temperature Physics. By Dr. B. Bleaney, F.R.S., and Dr. R. Bowers	807
Obituary: Prof. F. W. Oliver, F.R.S. By Dr. Agnes Arber, F.R.S.	809
News and Views	812
Research and Development in British Colonies, 1950-51	815
Technique of Electron Microscopy: Conference at St. Andrews. By Dr. D. G. Drummond and Dr. G. Liebmann	819
Medical Education in Turkey	821
Universities of Great Britain: Financial and Population Statistics for 1949-50	822
Personnel Management	823
Letters to the Editors: Resistant Peripheral Membranes of the Keratin Fibres.—Dr. E. H. Mercer; Dr. C. H. Bamford, Dr. A. Elliott and W. E. Hanby	824
Benefits to Aphids from Feeding on Galled and Virus-infected Leaves.—Dr. J. S. Kennedy	825
A New Type of Pathogenic *Mycobacterium*.—Dr. A. Nordén and Dr. F. Linell	826
Surgically induced Splenogenic Anæmia in the Rabbit.—Kurt I. Altman, Robert N. Watman and Kurt Salomon	827
Psychological and Biochemical Effects of Lysergic Acid Diethylamide.—Dr. W. Mayer-Gross, Dr. W. McAdam and Dr. J. W. Walker	827
Variation with Age in the Resistance of Bacterial Cells.—Dr. Helen R. White	828
Active Relaxation of Unstriated Muscle produced by Adrenaline.—Sunita Inderjit Singh and Prof. Inderjit Singh	829
Diffusion Respiration in Man.—H. Enghoff, M. H:son Holmdahl and L. Risholm	830
Fluorometric Determination of Natural Œstrogens in Urine; Elimination of Fluorogenic Compounds.—Michael Finkelstein	830
Determination and Occurrence of Fluorescent Substances in the Neutral Fraction of Urinary Extracts.—Prof. Bernhard Zondek and Michael Finkelstein	831
A Method for Administering Chemotherapeutic Agents to Chick Embryos.—L. H. Collier	832
Isolation of 2:3:4:6-Tetramethylpyridine from Coal Tar.—H. B. Nisbet and A. M. Pryde	832
Paper Chromatography of Flax Fibre Polyuronide Hemicellulose.—G. C. Whiting	833
Quantitative Chromatographic Separation and Estimation of Cadmium in Copper Alloys using Paper Strips.—R. L. Davies	834
Carbohydrate Primers for Q-Enzyme.—S. A. Barker, A. Bebbington and Dr. E. J. Bourne	834
Pregnan-7-ol and Pregnan-12-ol.—Dr. W. Klyne	835
Use of Nuclear Research Emulsions for Fast-Neutron Dosimetry.—Dr. H. A. B. Simons	835
A New Calculation of the Cohesive Energy of Metallic Beryllium.—B. Donovan	836
Mechanical Properties and Structure of Sol-type and Gel-type Gelatine Films.—E. Bradbury and C. Martin	837
Magnetic Properties, Internal Strains, and the Bauschinger Effect in Metals.—By N. H. Polakowski	838
Large Prime Numbers.—Dr. J. C. P. Miller and D. J. Wheeler	838

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INTERNATIONAL INSTITUTIONS

IN a book published a few months ago*, Mr. T. Besterman makes a praiseworthy attempt to set forth the activities of the United Nations Educational, Scientific and Cultural Organization and the ideas behind them. In a series of readable chapters he indicates how the Organization is working in the fields of education, science, the social sciences and humanities, and the conditions which determine its success or failure, and what has already been achieved in regard to reconstruction, mass-information and the exchange of persons. He establishes very clearly that there is room for such an Organization in the world to-day; but though in his final chapter his criticisms and conclusions deal with some important factors in Unesco's development, he does not quite succeed in grappling with some of the essential issues. His book, for all its merits, leaves the impression of over-optimism and of a head a little too much in the air.

A striking corrective to this little book and a wholesome stimulus to constructive thinking about the real and wider issues is a report which has been issued, partly under the imprimatur of Unesco itself and partly under that of the International Institute of Administrative Sciences, Brussels. Entitled "National Administration and International Organization"†, this report describes an inquiry conducted jointly by the two bodies with the view of improving international co-operation and the operation of the United Nations, the Specialized Agencies and similar bodies. It is open to criticism in that the inquiry was limited in scope and not sufficiently representative. The fourteen governments selected for the inquiry, although varying in size and responsibilities, are politically and culturally too homogeneous. The difficulties in the way of international collaboration and the conditions essential to make any body like Unesco effective would have been even more apparent had the Middle East, Far Eastern and backward countries been included. Outside Europe and America, India is the only country represented, and, in spite of the cultural diversity, its system of government is also founded on democratic principles.

Whether in India and in some of the other countries the conditions exist under which democratic principles can be served and a democracy function is another question, and this survey shows very clearly what an important bearing it has on international organization and co-operation. There cannot be, as this study shows, any standard pattern for administering the relations of national governments with international institutions: political traditions, the structure of organization, national resources and national interests vary too widely, though it is true that every government has something to learn from the administrative experience of other governments, particularly where their situations are comparable. Disregarding considerations of national policy, how-

* Unesco: Peace in the Minds of Men. By Theodore Besterman. Pp. xi+134+12 plates. (London: Methuen and Co., Ltd., 1951.) 10*s.* 6*d.* net.

† National Administration and International Organization: a Comparative Survey of Fourteen Countries. Report of an Inquiry conducted jointly by the International Institute of Administrative Sciences and Unesco. Pp. 78. (Paris: Unesco; London: H.M. Stationery Office, 1951.) 150 francs; 3*s.*; 50 cents.

ever, the study emphasizes that the level of international administration, in a society of co-operating sovereign States, can rise no higher than the level of national administration in those States. Deficiencies in national administration, whether they are due to personal failures or to the inherent unsuitability of the national organization to its social and economic conditions, are at once reflected on the international plane.

This is a point which is commonly overlooked in discussing international organization and plans for international co-operation, for example, in regard to technical assistance to the under-developed areas. It is brought out as strongly by this inquiry as in Mr. Besterman's book, and it is worth noting that it was equally emphasized by Dr. Herbert Greene and other speakers at the discussion, at the British Association meeting in Edinburgh last August, on surveys of under-developed areas. It provides the main reason for the concern of the scientific or technical expert with the subject of this inquiry and with the theme of Mr. Besterman's book.

The two main difficulties in international collaboration which are brought out by these publications are, first, the tendency of numerous governments to express different views in different places on related international problems; and secondly, the failure of all too many governments to discharge promptly and effectively their substantive obligations as participants in a co-operative international system. The first not only creates confusion but may also affect the soundness of the plans which are formulated. The second, however, could make the formulation and execution of plans a complete waste of time. It is the growing disregard for international obligations and the unilateral repudiation of negotiated agreements that is the most disturbing feature of to-day. If it is unchecked, it can halt all schemes for economic and technical assistance to backward countries. Technicians and scientific advisers cannot work confidently and effectively apart from some rule of law and guarantee of stability, nor indeed will it be possible to recruit them for such work. If they cannot be recruited, then the programme stops. In this connexion, the challenge which present events in Persia and Egypt thus presents to international institutions does not appear to have received the attention it demands.

The inquiry carried out by Unesco and the International Institute of Administrative Sciences, moreover, brings out that while the major responsibility for consistent, prompt and effective observance of international obligations by national governments rests with these governments themselves, such matters are no longer the affair of Foreign Offices and professional diplomats alone. A wide range of government departments and of technical and professional advisers may be involved, and what was once regarded as a matter of foreign relations is not easily distinguished from domestic affairs. For a government to pursue a reasonably stable and consistent course in its foreign relations, close and continuous liaison between the legislative and the executive is essential. Similarly, in democratic countries—and elsewhere—governments are now obliged to heed demands emanating from public opinion and from a variety of interested groups which find expression in various ways. As a corollary, the ethical standards of a government in its international relations are unlikely to be much above that of the standards of the community it governs.

It is this point, rather than the minor suggestions which are made in this report for improving administrative organization and methods of organization, that deserves attention at the moment. It is not suggested that any of the fourteen reporting countries covered by the inquiry was satisfied with the existing state of affairs, or that further improvements might not result from greater attention to the recruitment, selection and training of staff. This also is secondary, and though Mr. Besterman, too, directs attention to the unfortunate consequences of excessive turnover of staff and to the difficulties which can arise once any considerations other than that of professional competence enter into the selection of staff for a post, the dominant factor in efficient working and in securing an efficient international secretariat is the standard of co-operation and interest shown by the participating countries. Deficiencies in that respect cannot be offset by any scale of salaries designed to compensate for genuine expatriation and the speculative character of such employment. Indeed, it should be remembered that too lavish an endowment of such posts with diplomatic and taxation privileges may fail to attract staff of the integrity desired and also provoke criticism which may militate against co-operation. The personal character which is as essential as administrative ability for such posts will not be forthcoming, whatever the terms of remuneration, unless the work is manifestly seen to be worth while and enjoys the respect of professional bodies as well as of governments.

To strike the right balance here is admittedly not easy. Whether or not this is a contributory factor, Unesco at least scarcely seems to enjoy the standing among professional associations that many of its activities would warrant. Mr. Besterman's little book, by contributing to a wider understanding of what Unesco is doing, should in a modest way assist in increasing that repute. By and large, so far as science is concerned, Unesco's reputation and influence must depend on the extent to which the value of its projects becomes known to the scientific world through its links with the international unions and other professional bodies. In Great Britain the newsprint position is a severe handicap in making the work of Unesco better known, but even so the position is unlikely to be remedied by the circulation of Unesco's own publications. Indeed, on Mr. Besterman's own showing, contraction might be a wiser policy than expansion here, if appropriate arrangements could be made with existing publishing bodies.

For all the valuable work that Unesco has undoubtedly done in its five years or so to meet some of the world's needs in the field of education, culture and learning, and to strengthen some of the international bodies already working in those fields, it is difficult to regard the immediate situation with con-

fidence, still less optimism. As Sir John Maud recently pointed out, Unesco itself has now established a growing number of personal and professional relations between the men who are chiefly responsible for educational and scientific progress in their own countries. Outside Unesco, the programme of technical assistance to the backward areas would seem to offer a most encouraging vista of international co-operation and understanding.

All this, however, is overshadowed by the failure of member States of the United Nations to keep faith and to honour obligations into which they have entered. The very facts, on which this inquiry into national administration and international organization rightly insists, that distinct boundaries between domestic and international problems no longer exist, and that the conduct of foreign affairs must be regarded as an inseparable part of the larger problem of organization for the conduct of national affairs as a whole, make it essential that there should be some common standards of value among the participants in any form of international organization. Without such standards, misunderstandings, frustrations and acerbity, leading ultimately to anarchy, are inevitable.

It cannot be too strongly insisted that good faith and the observance of negotiated agreements and obligations are a *sine qua non*, and in their absence minor improvements in administrative procedure are irrelevant. In the limited sphere of Unesco, the irresponsible disregard of obligations which Mr. Besterman notes is made more invidious by the fact that rather more than half Unesco's income comes from the United States and the United Kingdom; of the other members, only France and China contribute even 7 per cent. In spite of this, all members have equal voting rights. Mr. Besterman rightly points out that reconsideration of this egalitarian principle is unavoidable if certain nations and groups of nations continue to manifest the irresponsibility in voting and in observing obligations which have marked recent years. In view, moreover, of what is happening in the wider context of the United Nations, it may well be asked if the time has not already come for the United Kingdom to consider whether it can continue its own contribution to such organizations on the present scale, or whether it should not concentrate the resources it can spare for the furtherance of international understanding in more limited organizations where there exists a standard of goodwill and honesty of purpose which make effective co-operation possible.

The latest annual report of the Secretary-General of the United Nations points to the need for realistic thinking here. One of the functions of the United Nations is to provide a common ground on which antagonists can meet to resolve their differences. It was proposed as an organization affording each nation a forum in which it could argue its case as an equal. Only the conduct of the members of the Organization can show that Mr. Trygve Lie is right in maintaining that the Organization's function as a forum need not frustrate its function as policeman, and the evidence since his report was written is very much the other way. If the Security Council and other organs of the United Nations continue to condone the flouting of international agreements and of the authority of international institutions by governments pledged by their membership of the United Nations to observe a code of good behaviour, it may well be asked whether it is worth persisting in membership. Whatever the immediate outcome of the recent unilateral repudiation of agreements in the Near East, fresh thought must be given by Great Britain to the implications of such incidents before the country is committed to further large obligations in any international organization where there can no longer be presupposed the essential basis of good faith and respect for such obligations by all contracting parties.

ANTHROPOLOGY AND SOCIAL STUDIES

The Foundations of Social Anthropology

By Prof. S. F. Nadel. Pp. xi+426. (London: Cohen and West, Ltd., 1951.) 25*s*. net.

Society

An Introductory Analysis. By Prof. R. M. MacIver and Prof. Charles H. Page. Pp. xix+698. (London: Macmillan and Co., Ltd., 1950.) 25*s*. net.

SOCIOLOGY and social anthropology are closely allied subjects. Apart from this, there is no real reason for comparing these two books. Profs. R. M. MacIver and Charles H. Page have produced a summary of present sociological knowledge. They progress from one aspect to the next, until the whole panorama of their subject is displayed. The book has the merits of all good encyclopædic work, and will be invaluable as a bibliography and as a teacher's book of reference. At the same time, it inevitably carries the flatness and finality of a text-book.

Prof. S. F. Nadel, on the other hand, has written, not a summary of anthropological knowledge, but an inquiry into the nature of sociological knowledge. As he says, social anthropologists have had a tendency to apologize about their subject. The societies they study have often no written records, the language may never have been studied, and the environment and customs are strange; in face of these difficulties, their techniques are necessarily 'tentative' and their concepts 'fluid'. For these reasons he has undertaken now a book about method, rather than one about results (with which he considers anthropologists have hitherto been too exclusively concerned). His training in logic qualifies him well for a work which aims at defining the place of anthropology among the sciences, by linking the 'study of man' with the whole universe of scientific knowledge.

Prof. Nadel considers that such a wealth of ethnographical data has been assembled in the past three decades that an "era of systematization" is now due. These data he speaks of as raw material awaiting the "fuller synthesis" which will "lead to valid generalizations on primitive culture and society". His view that the time for such a synthesis is near is shared by others who also exhibit his interest in methodology, but its truth may be questioned.

Even after studying his argument one is forced to doubt whether the ethnographer's material, however

systematized, is yet capable of yielding a single valid generalization. It is to be hoped that at some later stage he will himself publish much more fully the results of his own valuable research among tribes in Nigeria and the Sudan. Only a few anthropologists have justified the claim that Prof. Nadel makes for their research, as distinct from traditional sociology, that it is both more intensive and comprehensive. Few have remained sufficiently long in any single society to produce a study that goes beyond the broad outlines which give a misleading impression of sameness from one society to another. The few who have achieved the highest standards unfortunately stand alone as experts on widely separated regions. In short, comparative work within a given region on the basis of modern intensive study has scarcely begun.

Prof. Nadel rightly claims that its subject-matter provides for social anthropology data which differ from those of sociology; instead of considering class-structure or heredity and environment, it is faced with problems of taboo, clan exogamy or totemism. But original data have not, in fact, produced new sociological theories. A personal interest in methodology may have tempted him to hope that systematization will one day yield generalizations about society, but one may equally well argue against him that in sociology the process has worked usually in the opposite direction. The fact-collecting and systematization directed by the Victorian anthropologists were stimulated by hypotheses about social evolution and cultural diffusion. Similarly, in the United States to-day a vast amount of research has been undertaken to test current theories about the relation between culture and personality. In this subject, at least, it seems that theories produce facts and not vice versa.

Since the 1920's, when Malinowski raised the standard of field-work, and Prof. A. R. Radcliffe-Browne set a sociological scaffolding around ethnology, the stimulus they gave to social anthropology has to some extent evaporated. The history of philosophy shows that a branch of learning develops a dominant preoccupation with methodology only in its relatively sterile periods, and certainly many exponents of social anthropology seem deeply concerned with its status and methods. It must be admitted that no major speculative theory has appeared which compares with those which inspired the Victorian anthropologists.

As a minor criticism of the scope of Prof. Nadel's work, it may be remarked that a book of this size gives unduly little space to the serious problem of how there can be reliable knowledge of social phenomena for an outside observer whose language and categories of thought belong to an alien culture. This is only sketchily touched upon in a dozen pages on "Observation and Description".

In certain branches of sociology the need for the stimulus of sweeping sociological theories does not seem to be felt. The impetus of most of its research derives ultimately from the moral conscience, the concern to remedy pressing social evils. The relation between academic knowledge and social reform is generally close. Anthropologists, on the other hand, find it difficult, though some try strenuously, to justify their work on strictly practical grounds. The scope and character of their studies in alien societies make them, indeed, more wary than enthusiastic for social change. If it is called into play at all, their moral conscience tends to find itself opposing schemes for social advance.

The book by Profs. MacIver and Page, in spite of proper magisterial detachment, reflects in its subject-matter the characteristic preoccupation with social problems. It is divided into three parts. After only a few pages of definition, the first plunges into the relations between the individual and society, co-operation and conflict, society and environment, and then on to social control and the problem of moral liberty. Part 2 covers the major forms of social structure, and Part 3 social change. The book is admirable as a summary, but is not intended as a criticism of current trends of thought. It is in the nature of a good text-book to draw on pre-suppositions which are already a little out of date, and this one is faithful in reflecting the prejudice and weakness as well as the strength of contemporary sociology. This is particularly noticeable in the unconscious bias against religious organization in the section on conflict between religion and morals, which is more significant in view of the later chapter on "Evolution of the Church as a Social Form". This section is based on assumptions which have been challenged by important modern publications on primitive religion and magic.

Mary Douglas

COLLOID SCIENCE

Colloid Science

Edited by Prof. H. R. Kruyt. Vol. 2: Reversible Systems. Pp. xix+753. (Amsterdam and New York: Elsevier Publishing Co., Ltd.; London: Cleaver-Hume Press, Ltd., 1949.) 77*s.* 6*d.*

It must be said first that this is not a text-book on colloids; rather it is a record of the work of the Dutch school under the distinguished leadership of Prof. H. R. Kruyt, and the volume suffers from the limitations thereby imposed. This factor will probably be unimportant in Volume 1; but in the present volume it is serious.

The writers, faced by the almost insurmountable difficulties of finding a logical order of dealing with colloids and their properties, have chosen the thermodynamic classification into reversible and irreversible. Volume 2 deals with the former, which includes macromolecules and association micellar colloids. Macromolecules receive 211 pages, gels and solid macromolecules 193, while coacervation with related topics occupies 248. Micellar colloids are compressed into 37 pages, of which about half is taken up by coacervation. Thus 40 per cent of the book is of little interest to the majority of colloid chemists. It is stated in the introduction that the work on coacervation is included because of its inaccessibility to English and American readers; it should, however, have been published as a separate monograph. It seems most unfortunate that the name 'coacervation' has been extended to the clear case of macromolecule-solvent systems separating into two layers without clear proof that Bungenburg de Jong's 'coacervation' is the same phenomenon. In this book, the two cases are discussed in separate sections.

The book is a collective work to which the contributors are: R. Houwink, J. J. Hermans, P. H. Hermans, J. Overbeck, Bungenburg de Jong and H. L. Booy. The editing is very good; in this subject, in which basic ideas and nomenclature current in the literature are often far from clear, as in the word 'colloid' itself, or even grossly misleading as 'emulsoid', the need for clear definition is para-

mount. This has been achieved in the book under review, though how far it is due to editing and how far to clear thinking by the Dutch workers over a number of years cannot be said; whichever it is, the credit is due to Prof. Kruyt. It should be read word by word more than once. Its particular merits are that it stimulates and disciplines. It is suitable for advanced students and research workers interested in colloids, and should find a place wherever colloids are studied seriously.

It will be most interesting to see in Volume 1 how the authors deal with irreversible colloids, for which the thermodynamic approach to stability is so much less useful than the kinetic. There is a real danger to-day that research workers dealing with macromolecular colloids may be lamentably ignorant of the other types. This is due in part to the common habit of young workers of regarding investigations more than about ten years old as obsolete; and in part to nomenclature and the need for revision of the treatment of the classical colloids. It is as well to remember that there is one basic and fundamental property only common to all types, namely, the large size of the free kinetic unit of the solute. Can one imagine a book on ordinary solutions which did not mention the colligative properties? We must recognize that although many of the properties, especially their commercially useful ones, depend upon the interaction between particles, the single molecule, whatever its size, still remains the fundamental chemical unit, and it can still be studied only in ideal solution, that is, at a dilution such that mutual interaction effects are reduced to zero. There is nothing new in this situation: exactly the same applies to metals. The confusion really arises from the word 'colloid'. Is there such a thing, or are there only colloidal solutions? The answer is, of course, that the colloidal state is a state of dispersion, and that there is therefore no such thing as a 'colloid'.

A. S. C. LAWRENCE

FREE-LIVING NEMATODES

Soil and Freshwater Nematodes

A Monograph. By Dr. T. Goodey. Pp. xxvi+390. (London: Methuen and Co., Ltd.; New York: John Wiley and Sons, Inc., 1951.) 45*s*. net.

THIS monograph by Dr. Goodey will be welcomed not only by specialists but also by the general zoologist. To the latter the nematodes are a somewhat troublesome group: they are superficially so similar, there are so many of them, they are so widespread and the relevant literature scattered. Dr. Goodey previously published a useful volume on the nematodes parasitic on plants which gave access to these forms; but there are still a large number commonly found living free in the soil and in fresh water. It is to these that the present book is devoted. Many of the plant parasites are also to be found in the soil and so are included, but only as soil inhabitants, since details concerning their relationship with the host plant are to be found in the other volume.

The systematic arrangement to a considerable extent follows that of Chitwood and Chitwood, starting with the two main sub-classes Phasmidia and Aphasmidia. This division rests, in the main, on the presence or absence or reduction of the curious, paired, possibly sensory organs, termed phasmids, situated in the lateral areas of the caudal region.

The introduction includes a useful section on the technique of handling nematodes and an account of their structure sufficient to follow the systematic definitions that follow. A uniform treatment is adopted throughout and the descending classificatory groups are clearly defined down to genera. For each genus, in addition to the definition, there is a more detailed description of one species, accompanied by diagrams sufficient for accurate diagnosis. The species generally chosen is the genotype; but, where this is unsuitable, for example, if it is marine, another typical, more accessible species is described.

The illustrations are comprised in 190 figures in the text, but as each figure contains three, four or five diagrams a very large amount of information is conveyed. Most of these line block illustrations are excellent, but a few suggest they have been reproduced from worn or inadequately inked blocks. In the review copy Figs. 53 and 98 are examples. The treatment does not extend to descriptions of species, but under each genus is a list of the recognized species accompanied by a brief reference to the original description. As a number of species in a genus may be large—*Dorylaimus* contains 195 species and ten additional varieties—treatment of the individual species would require a number of volumes the size of the present one and would prove too unwieldy and expensive to have a wide appeal. At the conclusion of the account of each genus is a paragraph on its bionomics, and in looking through these the reader is at once struck by the large gaps in many genera. In some genera, as in *Aphelenchoides*, where a good deal is known, a letter after the specific name indicates whether it is an obligate plant parasite, saprophagous, connected with insects or predatory. Thus a great deal of information is conveyed in a concise manner.

In fact, to the reviewer, conciseness is the most outstanding feature of this book; indeed, it is remarkable how much information is contained within its 390 pages. The last part of the book, apart from an adequate index, is a list of references. Here again this is a selective bibliography, and the further references that can be obtained easily from Stiles and Hassall's catalogue or the *Zoological Record* are not included unless for a special purpose.

The author is to be congratulated on producing a volume that, like its predecessor, will be an essential to all interested, however remotely, in the field it covers.

C. H. O'DONOGHUE

RECENT DEVELOPMENTS IN METAL PHYSICS

Progress in Metal Physics, 2

Edited by Dr. Bruce Chalmers. Pp. viii+213+23 plates. (London: Butterworths Scientific Publications, Ltd., 1950.) 45*s*.

THE appearance of the second volume of this series is most welcome, and all interested in the science of metals will find much of value. In the reviewer's opinion the editor has been wise in refusing to make the book a report on the progress in any one period, and in again presenting a series of self-contained articles most of which can be read with profit by an honours graduate in metallurgy, physics or chemistry with no specialized knowledge of the subjects concerned. The standard of writing varies, and some articles would have profited if the authors had

submitted their manuscripts for criticism, not only by experts in the subject but also by the general reader for whom the book is intended.

The first paper, by H. Lipson, on "Order–Disorder Changes in Alloys", is a model of its kind, beautifully written and illustrated, and arranged so that the reader's attention is continually directed to the important points. The next review, by I. I. Betcherman on "Rate Processes in Physical Metallurgy", is less satisfactory. It covers a wide range, but some of the writing is too superficial to be of real value, while the description of the work of Frederickson and Eyring is confusing; there are also several misleading legends to the figures. The third paper, by W. Boas and J. K. Mackenzie on "Anisotropy in Metals", is excellent, and the description of a wide range of properties should be most stimulating to those who are prepared to cope with the rather formal introduction to the ideas of the mathematics of the vector–vector relations. The paper by H. G. Warrington, on "Developments in Magnesium Alloys", seems rather out of place, since much of it is concerned with technology rather than with fundamental metal physics. The atomic radii given on p. 137 are not the quantities usually known by this name, and it is strange to find no reference to the work of G. V. Raynor on magnesium alloys.

The last fifty pages are devoted to a symposium on polygonization, introduced by a paper by R. W. Cahn on "Internal Strains and Recrystallization". This is stimulating and suggestive, but in some parts it is rather premature and, as in the later papers, the description suffers from the fact that the author accepts the dislocation hypothesis so completely that what are really interpretations in terms of the hypothesis sometimes appear as statements of fact. It must not be forgotten that, however great the promise of the hypothesis, it is supported by little direct experimental evidence, and has led to the prediction of relatively few facts before their discovery. The paper by A. Guinier and J. Tennevin, on "Polygonization", is interesting and beautifully written, while the final contribution, by C. Crussard, F. Aubertin, B. Jaoul and G. Wyon, describes "Polygonization in Strongly Deformed Metals". The volume thus covers a wide range and should be read by all concerned with the physics of metals.

W. Hume-Rothery

CANCER FOR THE LAYMAN

Cancer

Where we Stand. By Prof. Sidney Russ. Pp. xv+192+16 plates. (London, New York and Toronto: Oxford University Press, 1950.) 10*s*. 6*d*. net.

WE are all interested in the subject of cancer. There are few whose families and friends have not included someone who has died of cancer. Malignant disease has a terrible reputation. Nevertheless, a substantial proportion of people suffering from many types of cancer have been completely cured by means of surgery or radiotherapy or by the combined use of both these methods of treatment. Most intelligent people know that with early diagnosis and prompt surgical treatment, many forms of cancer can be successfully eradicated. Few, however, appreciate the achievements of radiotherapy. The statistics published during the past few years show that for new cases of cancer of all types treated by radiation, and excluding the almost completely curable basal cell carcinoma, the corrected survival-rate is almost exactly one-third after five years and one-quarter after ten years. For similar cases treated twenty-five years ago, the five-year survival-rate was about one-eighth. It seems reasonable to assume that one of the most important factors responsible for this improvement has been the application of physics to radiotherapy.

Prof. Sidney Russ is one of the leaders of the group of British physicists who have contributed so much to these applications of physics to the treatment of cancer. It is evident that for many years he has thought about the problem of cancer from many angles. The study of cancer is still outside the main stream of biological teaching, and it is difficult for the intelligent layman to acquire an objective elementary knowledge of this field. With a sense of duty, Prof. Russ has attempted the almost impossible task of writing a simple and accurate account of the present position with regard to the scientific study and medical diagnosis and treatment of cancer. In my opinion he has succeeded admirably.

The book starts with an account of the nature of cancer and theories of its origin. The second chapter is a useful discussion of the prevalence of cancer and of the public attitude to malignant disease. The results of the surgical and radiological treatment of cancer are set out clearly in a later chapter. I think that the best part of the book is the discussion of the results of treatment and the logical insistence on early diagnosis and prompt treatment with a minimum of delay.

A great deal of information about radiological physics and many biological subjects such as cancer throughout the animal kingdom and occupational cancer are skilfully introduced. The chapter entitled "Historical Notes on Cancer and its Treatment" is interesting and should convince anyone of the folly of reliance upon treatment by quacks. Appendix 3, at the end of the book, includes a very simple statement of what should be known about cancer, with much good advice.

The chapter on research in cancer, together with the short chapter on palliative chemotherapy, introduces the general reader to some of the important lines of thought in these fields.

The last chapter is entitled "Cancer in the Future". In it, Prof. Russ puts forward a number of suggestions for the advancement of the treatment of cancer, with which I think there is general agreement. I would like to suggest that the knowledge that present methods of treatment are much more effective than is commonly realized should encourage people to seek medical advice without delay. It is, of course, essential that greater hospital facilities for the diagnosis and treatment of patients with cancer should be provided in order to utilize more fully for the benefit of the individual patients the best methods of treatment available at the present time.

Of the suggestions made by Prof. Russ for the further encouragement of experimental cancer research, I think that special mention should be made of the need for greater inducement to research workers outside the purely medical sciences to participate in this field.

This little book is well produced and has interesting illustrations. A number of references are given in the text. I should like to suggest that, in a subsequent edition, a limited bibliography would add to its value.

J. S. Mitchell

Biology of *Drosophila*

Edited by M. Demerec. Pp. x+632. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1950.) 80*s*. net.

A BOOK with this title ought to be a summary of the behaviour, feeding, mating and larval habits of all the numerous species of *Drosophila*, seen in relation to insect life as a whole, and to the special roles of this genus as an introduced pest into temperate climates and as a laboratory animal. This one is not. Only the last chapter, "Collection and Laboratory Culture" by Warren P. Spencer, concerns the insect as a whole, and contains much practical advice to all who need to trap flies and rear them in the laboratory. The other six chapters, "Normal Spermatogenesis" by Kenneth W. Cooper, "Early Embryology" by B. P. Sonnenblick, "Histogenesis, Organogenesis and Differentiation in the Embryo" by D. F. Poulson, "Postembryonic Development" by Dietrich Bodenstein, "External Morphology of the Adult" by G. F. Ferris and "Internal Anatomy and Histology" by Albert Miller, deal only with bits of the animal, and of course refer almost exclusively to *D. melanogaster*.

The real purpose of this symposium is to provide a handbook of what is considered 'normal' in the morphology, histology, embryology and post-embryonic development of *D. melanogaster*, a standard of reference by which the vast amount of experimental work on this fly can be assessed. Deciding what is 'normal' is necessarily a strongly subjective process; but the work is extremely well documented and includes some references up to 1947. The numerous illustrations, including many excellent photomicrographs, are very clearly lettered, and the account of post-embryonic development includes a chronological table of events as they take place in the 'normal' fly at 25° C. G. F. Ferris's section on external morphology presents a personal point of view that diverges considerably from generally accepted views, especially in trying to avoid such apparent discontinuities as exist between the mouth-hooks of the larva and the mouthparts of the imago.

The geneticist, the embryologist and the insect morphologist will all find this symposium a valuable guide into collateral fields of study, while the general entomologist, and especially the dipterist, will welcome such an exhaustive study of one species. It is a pity about the title. H. Oldroyd

Introduction to Electron Optics

The Production, Propagation and Focusing of Electron Beams. By V. E. Cosslett. Second edition. Pp. xvi+294+8 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1950.) 27*s*. 6*d*. net.

THE second edition of Dr. Cosslett's well-known book is a photographic reprint from the first edition, with some mis-statements and misprints corrected. The text thus differs little from the original, but a series of notes on more recent work has been added, as well as some numerical examples on the more theoretical chapters. The first edition appeared before many of the advances made during the Second World War were made public. It is therefore regrettable that the final third of the book, dealing with applications of electron optics in research and industry, has not been rewritten to include the progress made in electron microscopy, particle acceleration and the generation and amplification of centimetre waves. However, the book is written mainly for students and those commencing research work, and it must be judged in this light. The first edition was always highly regarded as being an excellent introductory text, and the new edition should maintain this good reputation.

Orkney

By Hugh Marwick. (County Books Series.) Pp. viii+287+49 plates. (London: Robert Hale, Ltd., 1951.) 15*s*. net.

NO part of Scotland is richer in prehistoric remains than the islands of the Orkney group. Both habitations and burial places are numerous, and all seem to begin in Neolithic times. These matters are described and discussed in this book, and well illustrated by photographic plates. But the volume is not only archæological. All aspects of the islands are treated, though the natural history perhaps has least notice. There are, however, other books on these aspects. Agriculture gets adequate notice. The islanders depend almost wholly on this for their prosperity, their exports being eggs and cattle, and some lobsters. There are no industries, though the manufacture of tweed is beginning. Population has been falling for the past hundred years, and only twenty-seven of the sixty islands have any inhabitants; and several have only one farm or a lighthouse. The book has an adequate map.

The Land of Britain

Its Use and Misuse. By L. Dudley Stamp. Second edition. Pp. viii+507. (London, New York and Toronto: Longmans, Green and Co., Ltd., in conjunction with Geographical Publications, Ltd., 1950.) 45*s*. net.

THIS valuable book, first published in 1948, has now been re-issued in what the publishers describe as a second edition; little if any change, however, seems to have been made in the text. The bibliography is unaltered and stops at 1946, although some valuable reports and books published since that date might well have found a place. Also there still remain the puzzling discrepancies between the official statistics of land utilization in England and Wales as published by the Ministry of Agriculture and those as quoted on p. 481: up to 1939 the figures agree with those of the Ministry, but for 1940–46 they do not, and no explanation is given. Also the figures stop at 1946, but the later ones, which are very interesting, are available. A completed table brought up to date would have been very helpful; in no other readily accessible volume are these important statistics assembled on one page as they are here.

The need for a re-issue shows how widely the book has been appreciated. Nowhere else can the student find so full and authoritative an account of the land of Britain or so good a summary of the labours of the devoted band of workers who carried out the classical Land Utilization Survey on which it is based.

The original Survey was carried out in 1931 and 1932, and, since then, British agriculture has undergone profound changes. Would it be possible to repeat the Survey now that twenty years have elapsed, so as to have a full record of these changes? The information would be invaluable for those whose task it is to direct the new agriculture, and there still remain a sufficient number of the old workers to ensure that the results would be comparable with those of the 1931 Survey. E. John Russell

AGRICULTURAL RESEARCH IN THE GROUNDNUT SCHEME, 1947–51*

By Dr. A. H. BUNTING

Recently Chief Scientific Officer of the Overseas Food Corporation

THE Overseas Food Corporation has recently decided, following the curtailment of the scope of its operations in Tanganyika, to reduce the scale and to revise the organization of its agricultural research services. As a preliminary to this reorganization the post of chief scientific officer has been abolished, and steps are under consideration by which part of the work formerly conducted by the Corporation may be transferred to other agencies. It seems appropriate at this juncture to record in outline the objects and the results of the work up to the present time.

The Scientific Department of the Corporation was founded by my appointment as chief scientific officer on January 30, 1947. Its task has been to assemble the technical knowledge necessary for the successful establishment of systems of mechanized crop production in the Corporation's areas of Tanganyika. To carry out this task the Department has developed a considerable organization for field investigations and for supporting laboratory work.

The European research staff in the crop season of 1950–51, including agricultural trainees attached to the Department, numbered thirty-eight, of whom eighteen were academically qualified. This staff, aided by African assistants trained in the Department, operated three fully mechanized experimental stations, ranging in size from 800 to 1,000 acres, at Kongwa, Urambo and Namanga, near Nachingwea, in the Central, Western and Southern Provinces of Tanganyika respectively. The headquarters of the Department, including the statistical and chemical laboratories, are at Kongwa.

Questions arising from the work of the Department which require a more fundamental attack have been passed, wherever possible, to the East African Agriculture and Forestry Research Organization for study. Collaboration has also been developed with the official agricultural and related technical services in Tanganyika, and in practically all other territories of tropical Africa, in Australia, in the United States and in many other countries, and notable help has been received from university departments and official and commercial research organizations in the United Kingdom. The chief scientific officer was a member of the East African delegation to the African Regional Scientific Conference in Johannesburg in October 1949.

The research programme has been based on a broad general exploration and assessment of the edaphic, environmental and biological factors operative in the three regions. This has included the assembly of meteorological data, with special reference to rainfall in the Kongwa area, the generalized pedological study of soils, particularly in the Kongwa and Southern Province areas, and extensive botanical and entomological collections of species of economic interest.

* Based on an address to the Fifth Annual Conference of the Scientific Department, Overseas Food Corporation, held at Kongwa, Tanganyika, August 18–20.

Soil Studies

A fairly clear qualitative idea has been gained of the fertilizer needs of crops on the more important soil types of the three areas. In general, it has been established that it is necessary to use phosphate for all crops, with nitrogen, usually as a top dressing, for sorghum, maize and other non-legumes. The quantitative study of fertilizer needs has more recently received closer attention, and it is clear that on some soils, at least, about 0·2 cwt. P_2O_5 per acre is sufficient to give an economically satisfactory response, although the economically optimal levels of application have not yet been precisely determined. Residual effects of phosphatic and organic manures, which have been found in field experiments, are now receiving closer attention, and work has begun on the effect of grasses on the soil nitrogen cycle (including the removal of nitrogen by leaching), with special reference to the possible role of grass courses in the conservation of soil nitrogen. In collaboration with members of the staffs of the Empire Cotton Growing Corporation and of the Tanganyika Department of Agriculture an initial examination has recently been completed which strongly suggests that *Tridax repens*, a common weed at Ukiriguru, in the Lake province of Tanganyika, plays an important part in the mobilization of soil phosphate. In 1951, an experiment on the nutrition of tobacco showed that quality in Virginia flue-cured tobacco at Urambo is dominated by the balance of nitrogen and potash. This result may have a profound effect on the future of tobacco production in Tanganyika, since it appears to be possible, by the correct use of fertilizers, to produce a tobacco free from the 'tang' which has been so characteristic and adverse a feature of Tanganyika tobacco in the past.

Crop Research

A systematic programme of crop introduction, from tropical and subtropical countries in all continents, has provided much valuable material, most of which was new to Tanganyika and in many cases to East Africa as a whole. The groundnut collection includes about 250 varieties, from which new, long-season types with seed dormancy are being developed to facilitate groundnut production in wetter areas, where harvesting of short-season types has at present frequently to be undertaken before the end of the rains, and to aid in the fight against the rosette virus disease of the crop (see below). The sorghum collection contains more than 160 varieties and has been the basis for all commercial production of this crop by the Corporation so far. The ideal type of sorghum for mechanized production in Tanganyika appears to be a stout-stemmed, rust-resistant dwarf, with a well-exserted head of shallu type, small glumes and a light-coloured giant grain of the Kifaru or Kaura type, developing a horny peripheral layer at maturity as a protection against storage pests.

All the necessary characters for such a variety are represented in the sorghum collection.

Safflower was introduced to East Africa, probably for the first time, by the Corporation, and may yet become a useful combine crop for the drier areas. It may even find a place as a late-planted crop in the wetter areas on suitable sites, extending the peak periods of planting and harvesting.

The soya bean collection contains about seventy varieties. Certain of these have transformed the prospects of this crop in Tanganyika, as a result of the recognition of the limiting effect of equatorial day-lengths on growth and yield in all varieties of soya in use in East Africa hitherto. The standard South African, Rhodesian and American types of soya bean, when exposed to equatorial day-lengths, receive the flowering stimulus at a very early stage and give small plants and poor yields. For success in Tanganyika, especially in mechanized production, a soya variety must be sufficiently tolerant of short days to produce considerable vegetative growth before accepting the flowering stimulus. Six such varieties obtained from equatorial or subequatorial territories are now in the possession of the Department. Four of them, in a formal trial at Urambo in 1950–51, yielded 1,500–1,600 lb. per acre, against 100–900 lb. for the other types tested.

Much attention has been given to maize and also to minor crops, and particular interest is attached to recent work at Urambo on the mechanized production of paddy rice, and to the pilot-scale development of Turkish tobacco production at Kongwa.

The agronomic programme has led to elementary investigations in crop physiology at points of economic importance. Studies of root distribution in soils and subsoils have added to the understanding of crop behaviour at Kongwa and Urambo. In 1950 a preliminary investigation, using the techniques of growth analysis, was carried out on the development of the groundnut crop. It showed, *inter alia*, that in the short-season variety, Natal Common, about one-third of the final yield of kernels is laid down in the last fortnight of the life of the crop. This result has been confirmed in 1951 by harvesting experiments.

Soil Management

In the field of soil management, a study has been made over three seasons of moisture relationships in Kongwa soils. This has shown that while no moisture accumulates at Kongwa under continuous cropping, considerable reserves can be built up by bare fallowing in a dry farming rotation. The gypsum-block technique is being used in these investigations to follow variations in the amount and distribution of available soil moisture. At the same time field experiments have indicated the very considerable advantages to be expected from bare fallowing: in the case of groundnuts 300 lb. additional kernels per acre have been obtained as a result of bare fallowing, the yield being raised from 700 to 1,000 lb. per acre. The crucial importance of weed control, particularly in the earlier stages of the life of crops, has also been shown at Kongwa.

A simple ridge and furrow system of ploughing, set out on the contour, has been evolved at Urambo as an addition to normal soil conservation practice, in an attempt to control surface wash and to reduce ponding and excess moisture in seed beds. Experience in the abnormally wet season of 1950–51 at Urambo has been very encouraging, and the method is now under trial in French West Africa as well as in Tanganyika.

It has been demonstrated that the avoidance of soil compaction, which was once regarded in some circles as a major and practically insoluble problem, is entirely a question of intelligent soil management.

On general matters of cropping technique, much has been learnt about seed dressings, seed-bed preparation, sowing rates and methods, time and method of harvesting and related matters. A few long-term experiments, and several two-year trials, have been devoted to the examination of crop sequences and rotations.

Plant Protection

The Department's pathologists and entomologists have maintained continuous surveys of crop diseases and pests. All actual or potential biological enemies so far encountered have been identified, with the aid of workers in Britain and elsewhere, and a working knowledge of the bionomics of the more important organisms, leading already in a few cases to methods of control, has been obtained. Crown rot of groundnuts has so far received more attention than any other disease, because of the fear that it might be cumulative. This has not proved to be the case. Advances have been made towards the control of *Sclerotium* foot rot and *Cercospora* leaf spot of groundnuts. In the entomological field *Calidea dregei* has for the first time been followed through its annual cycle and the study of its control by means of insecticides has begun. Stem borers of sorghum and maize represent a most serious problem: their biology at Kongwa is now fairly well understood; but their control is difficult and would seem to require attention on an East African scale. Studies of the pollination of sunflowers have confirmed the view that the natural populations of pollinators are inadequate for large-scale production of the crop, and have increased our knowledge of the behaviour of wild bees in Tanganyika.

The outstanding piece of work in the plant protection field has been the study of the rosette disease of groundnuts and its aphid vector, *Aphis craccivora*. An adequate picture of the field biology has been obtained, and has led in one direction to the successful trial of systemic insecticides for the control of the disease, and, in another, to the study of the possibilities of a new and important means of biological control based on the provision of alternate hosts for the predators of the vector. The demonstration that dry-season volunteer groundnuts can carry rosette disease and its vector over into the new season has been followed by the discovery that certain long-season varieties exhibit marked seed dormancy, which delays the appearance of volunteers for many months and so automatically provides a close season to prevent the carry-over of the disease. More recent work suggests that some of these long-season types are, in addition, resistant to some forms at least of rosette disease.

Scarcely less important has been the demonstration that benzene hexachloride, placed near the seed at planting time at the rate of about 4 oz. gamma-isomer per acre, can control the attack of termites on the standing crops as they approach maturity several months later. The biological staff have also given major help in such matters as seed selection, storage of agricultural products and the control of termites in buildings.

The attention of the Department has been so largely concentrated on field work that the laboratory side has seemed to occupy a second place. For a long time there were no laboratory facilities at all, yet valuable studies were carried out using portable or improvised equipment. For two years the headquarters laboratories were housed in tents; but on August 20, 1951, the Kongwa chemical laboratory, a well-equipped establishment of modern design, was formally opened after having been in use with temporary fittings for eighteen months. The remaining laboratories at Kongwa have been housed in converted accommodation for the same period. At all times, however, the Department has had a reliable routine laboratory service. The chemical staff have analysed many thousands of soils and of crop samples, and their work has also extended to the analysis of fertilizers, studies of the effect of shipment and storage on produce, work on the contamination of crops and analyses arising from pedological problems. Much help has been given to other departments of the Corporation, and the Scientific Department was responsible for the chemical aspects of the recent experiments at Kongwa on the artificial precipitation of rainfall.

The statistical section has been responsible for the design and analysis of more than seven hundred field experiments of modern design, ranging in size from 16 to 300 plots, and has had considerable responsibilities in the planning of programmes and in the evaluation and reporting of results. In addition to papers which have appeared in the specialist and technical Press, the Department has issued annual reports for 1947–48, 1948–49 and 1949–50, which have been summarized in the annual reports of the Corporation published by H.M. Stationery Office. The full data on which these reports have been based may be obtained in mimeographed form from the Scientific Department, Overseas Food Corporation, Kongwa, Tanganyika.

EIGHTH INTERNATIONAL CONGRESS OF REFRIGERATION

THE Institut International du Froid (I.I.F.), which has its headquarters in Paris, normally arranges for an international congress to be held every four years in one of its member countries. The intervention of the war years, however, broke the continuity of its meetings and no congress had been possible since that held in the Hague in 1936. For this reason the recent Congress, held at Church House, Westminster, during August 28–September 10, had more than usual significance, and the field of activity to be reviewed was particularly wide.

The presidency of the Congress was shared by the Right Hon. Viscount Bruce, of Melbourne, and Prof. W. J. De Haas, of Leyden. The Institute of Refrigeration in Great Britain undertook the arrangement of all meetings and functions. The attendance was approximately seven hundred, of which the proportion of overseas visitors was more than two to one. Thirty countries were represented.

The work of the Congress was divided among seven commissions, the subjects of which ranged from low-temperature physics and the low-temperature industry through all branches of refrigeration, including purely biological problems associated with the storage of food and other perishable materials, to problems of statistics and education in refrigeration.

In the meetings of Commission I, no attempt was made to embrace the general field of low-temperature physics, since by agreement this was delegated to the Oxford Low Temperature Conference held a few days previously (p. 807). One session was devoted to the subject of hydrogen and helium liquefaction. This meeting directed attention to the present situation, where there are now scores of laboratories throughout the world equipped to produce liquid hydrogen or helium. In the case of helium liquefaction, while many laboratories use the Simon direct-expansion type of liquefier, a description was given of a small completely automatic helium liquefier, employing a Collins expansion engine, which is now produced commercially in the United States. Dr. A. Wexler, of the Westinghouse Research Laboratories, Pittsburgh, also described a type of small metal Dewar vessel for liquid helium which has an evaporation loss of only one per cent per day. The vessels are shielded by liquid nitrogen boiling under atmospheric pressure. He suggested that larger vessels for storing liquid helium for as long as a year could readily be constructed.

A further session, devoted to thermodynamics, heard reports on the construction of thermodynamic charts for pure substances both by the Kamerlingh Onnes Laboratory, Leyden, and by the Heat Division of the Mechanical Engineering Research Organization (Department of Scientific and Industrial Research). So far, at Leyden, eleven diagrams have been completed and made available for the common industrial gases and helium; while the British body has also completed preliminary surveys for air, carbon dioxide, acetylene, propane and ammonia.

A paper by Prof. Jiro Oishi, of Japan, described a new experimental procedure for determining the absolute temperature of the ice point by the isotherm method. Two advantages were claimed: first, the elimination of dead-space errors, and, secondly, greater reliability of the results since the measurements can be confirmed by the use of at least six different gases in the thermometer. The mean value of the ice point determined by these experiments is 273·15, compared to the mean value of 273·155 obtained from the experimental results of all workers since 1929. Considering both sets of data and the absolute accuracy of the method, he proposed 273·15 to be the best value now available.

Measurements of heat transfer were reported by many authors both to Commissions I and II, the range of temperatures extending from normal refrigeration temperatures down to that of liquid hydrogen. New values for the thermal conductivity of liquid nitrogen were given by Prof. H. L. Johnstone, Ohio State University, while Prof. L. Weil, of Grenoble, gave values for the rate of heat transfer to boiling liquid hydrogen.

The greatly increased importance and activity of the low-temperature industry both in Great Britain and abroad was evidenced by the fact that no fewer than twelve papers were given on subjects connected with industrial gas separation and liquefaction. Many of these were concerned with plant for separating air into its constituents, from the scale of small transportable units mounted on trailers to single industrial units for producing 1,000 tons of oxygen a day. The increasing use of argon-arc welding for fabricating aluminium and alloy steels focused attention on methods of extracting this gas from the

atmosphere. The separation of ethylene from coke oven gas and from the gases obtained by the cracking of oil is another field in which low-temperature gas separation is now widely practised.

A further contribution to this session was an account of the work pioneered by Sir Alfred Egerton at the Imperial College of Science and Technology, London, into the utilization of liquid methane. Trials with motor vehicles adapted for running on liquid methane, carried in a vacuum-jacketed tank, have now totalled about 25,000 miles, of which the greater part has been made with buses in full passenger service. It is considered that sufficient knowledge now exists for the use of liquid methane as an automotive fuel to be considered for certain types of vehicles where methane is available. The use of stored liquid methane to meet peak loads at gas works was also discussed.

Commission III of the Congress was concerned with fundamental biochemical and biophysical studies related to refrigeration. Dr. P. Becquerel reported on experiments in which dehydrated organisms such as Protozoa, seeds, and spores of bacteria and fungi were mixed with iron alum powder and cooled by the magnetic method to within 0·2° C. of absolute zero. All the organisms frozen in this way recovered their full vital activity when thawed. It is thus shown that by the action of dehydration, vacuum, and extremely low temperatures it is possible to suppress the colloidal state of protoplasm necessary for biological changes without affecting its power to recover.

In organisms having a higher water content, the chance of survival decreases, although it was shown by Dr. L. Geneves in experiments in which microscope observations were made of cooling thin sections from the roots of the chicory plant that the disturbance of the cell structure by cooling was often reversible on thawing. Similar work was reported by Miss I. Modlibowska, East Malling Research Station, who directed attention to the causes of frost injury to fruit trees, relating it to the water content of the affected cells. The effect of low temperatures on the survival of animal cells was discussed by Dr. L. Bucciante. The usefulness of these researches was instanced by the present use of the low-temperature preservation of animal spermatozoa and of insulin in frozen pancreatic glands.

A novel approach to these problems described by Dr. W. H. Cook, National Research Council of Canada, involves the study of freezing processes in artificial cells constructed from 'Cellophane' or rubber. Films produced from these materials exhibit high resistance to penetration by ice crystals.

The effect of low temperatures on enzyme activity was discussed by Prof. M. A. Joslyn (California) and others. While this field is still only partially explored, it appears that the concentration of the substrate by freezing of some of the water may protect the enzyme and allow the continuance of its activity at lower temperatures than would otherwise be possible.

A further biological problem which arises in refrigerated food storage is the shrinkage and loss of weight of meat and fish which can occur on thawing, due to the extrusion of fluids from muscle. In this field a most valuable paper was presented by J. R. Bendall (Department of Scientific and Industrial Research) and Dr. B. B. Marsh, of New Zealand. They have been able to relate the shortening of muscle fibres and the consequent extrusion of liquid to the decline in the concentration of adenosine triphosphate in the muscle. The reversibility of the process has been demonstrated, and also its dependence on the *p*H value.

The present state of gas storage for apple and pears was outlined by Dr. C. West, of the Low Temperature Research Station, Cambridge. Wide experience has now been gained in the optimum refrigeration temperature and composition of atmosphere required for different varieties, and the importance of this method is such that it already provides storage for 80,000 tons of fruit in Great Britain alone. Other speakers reported its use overseas.

The work of other commissions covered the purely technical and engineering questions involved in the design of refrigerating machines and insulated chambers of all types. Facilities were also provided for members of the Congress to visit research laboratories and industrial installations in many parts of England and Scotland.

The occasion of the Congress was made the opportunity for drawing up and sanctioning extensive measures for the reorganization of the International Institute of Refrigeration under its new director, M. C. David. It is a matter of the greatest satisfaction to scientific men and refrigeration engineers in Great Britain that Dr. Ezer Griffiths was elected as the new president of the General Conference of the International Institute of Refrigeration; he is succeeded in his post as head of the Technical Board of the Institute by Prof. C. J. Gorter, of the University of Leyden.

G. G. HASELDEN

LOW-TEMPERATURE PHYSICS

THE conference on low-temperature physics, held at Oxford during August 22–28, constituted the second meeting of the Commission for Very Low Temperatures of the Union de Physique Pure et Appliquée, the first having been held at the Massachusetts Institute of Technology in 1949; and at the same time it formed part of the first post-war meeting of the Institut International du Froid, which has a Commission primarily interested in the pure physics of low temperatures. A conference on the technical and industrial aspects was held in London (p. 806) immediately after that at Oxford. Visitors were invited to the Royal Society Mond Laboratory at Cambridge on August 21.

A feature of the Oxford conference was the presence of a large number of younger research workers who, the organizing committee felt, had in general insufficient opportunities of attending international meetings of this kind. They were able to be there through the generosity of the Royal Society and a number of industrial organizations, the contributions of which substantially augmented the grant made by the Union de Physique from Unesco funds. The presence of a large number of delegates from the United States was ensured through the continued support of the Office of Naval Research.

Except for three introductory papers, contributions were limited in duration to ten, fifteen or twenty minutes. The total number was about a hundred and ten. A reporting system similar to that of the Harwell conference on nuclear physics (1950) was used, with the aid of fifty of the junior research workers, to make the report available in a few weeks.

In the following account, papers are grouped under the same four headings as at the conference.

Thermal Properties

A noticeable feature of this section was the general attempt to measure quantities such as specific heat, thermal conductivity and electrical conductivity over a continuous temperature range, where previously considerable gaps had existed. A number of workers have pushed these measurements below 1° K., and some private discussion took place on the temperature scale in this region. Discrepancies still exist between different laboratories even above 0·2° K.; below this temperature the discrepancies become considerable, but, until the problem of heat transfer to and from the paramagnetic salts used as cooling agent is solved, this does not seriously affect work except on the properties of the salts themselves.

Work on the specific heat anomaly in solid deuterium was reported by H. L. Johnston, and in solid hydrogen by R. W. Hill. It seems probable that the origin of the anomaly is splitting of the rotational degeneracy by the crystal field. Hill also reported that pure germanium shows no anomaly, and E. Estermann showed that the anomaly previously found is connected with the presence of impurity. Measurements on neptunium and thorium oxides (NpO_2 and ThO_2) (E. F. Westrum) showed that the anomaly in the former is magnetic in origin, like that of uranium oxide (UO_2).

Work on solid helium at high temperatures was concerned with the possibility of a critical point in the solid–fluid equilibrium. J. S. Dugdale reported that entropy measurements give no indication of approach to such a point, and that two phases have been found in the solid state, with a latent heat of transition. F. E. Simon suggested that these represent close-packed hexagonal and cubic states. The melting curve below 4° K. has been further investigated by C. A. Swenson. The melting curve of the light isotope, helium-3 (B. M. Abraham), has been measured between 1·5 and 0·16° K. Above 0·5° K. the melting pressure is $p = 26{\cdot}8 + 13{\cdot}1\ T^2$ atmospheres, while below it approaches a constant value of 29·3 atmospheres; this may be due to a transition in the liquid, or to the experimental difficulty of lack of heat contact with the paramagnetic cooling salt.

R. Berman reported that work on the thermal conductivity of dielectrics gives general confirmation of theory. The maximum in the thermal conductivity occurs at about a twentieth of the Debye temperature and amounts to 60 watts/cm. for sapphire. Work on solid helium (J. Wilks) is of interest because of its large change of density under pressure. The low thermal resistance of some crystals raises the possibility of observing 'second' sound in them. Work on the thermal conductivity of metals at Oxford and Ohio State University is concerned with the question of the minimum which, according to E. H. Sondheimer, is a rigorous consequence of the Bloch–Nordheim theory.

A considerable amount of work was reported on the electrical resistance of both pure metals and alloys, partly directed towards the discovery of suitable secondary thermometers and partly for comparison with theory. Hitherto, it has been generally accepted that the resistance reaches a constant value at low temperatures, but a number of metals show a minimum of resistance. E. Mendoza has investigated specimens of silver, gold and copper below 1° K. and finds a sharp increase in the resistance at the lowest temperatures. There seems to be no explanation for this at present.

Liquid Helium

In an introductory lecture, F. London surveyed the present position in the theory of liquid helium. Further work has revealed some of the limitations of the two-fluid model, though there is no doubt that this is basically correct. These limitations are connected with the existence of a limiting velocity in the rate of transfer, and the presence of dissipative forces at high rates of transfer. A more fundamental difficulty is the lack of a satisfactory molecular theory, although considerable progress has been made in the molecular theory of ordinary liquids. The fact that the light isotope, helium-3, shows no superfluid characteristics down to 0·25° K. suggests that the nature of the statistics, Bose–Einstein or Fermi–Dirac, must play an important part.

Measurements on liquid helium at Cambridge were reviewed by K. R. Atkins. Below 1·6° K. the velocity of 'first' sound approaches asymptotically the value 237 ± 2 m./sec., while previously the velocity of 'second' sound has been found to tend towards 152 ± 5 m./sec. at 0·2° K. The ratio of these velocities departs slightly from the simple Landau theory value of $\sqrt{3}$, but this may be due to dispersion.

Experiments on the flow of liquid helium II were mainly concerned with evaluating the nature of the frictional forces. The theory of Gorter and Mellink postulates a frictional force proportional to the cube of the difference of the velocities of the normal and superfluid. Measurements at Leyden, described by P. Winkel, have been designed to determine the proportionality constant and its variation with temperature; it seems possible that some interaction between the superfluid and the walls may have been present. Such an effect is suggested also by experiments of B. S. Chandrasekhar and K. Mendelssohn. Work at Cambridge, including a modified form of the Andronikashvili experiment, suggests that frictional terms involving only the velocities of the individual components may be present. R. Bowers discussed experiments in which the pressure at an intermediate point in the flow was measured, which indicated that frictional terms may only be required to explain flow above a certain critical rate.

Measurements down to 0·25° K. on the specific heat of liquid helium were described by H. C. Kramers. Above 0·7° K. the specific heat diminishes with a power of the temperature between 6 and 7, in agreement with previous work, but then changes rather abruptly to follow a third-power law at lower temperatures, with an absolute magnitude not in serious disagreement with that predicted by the theory of Landau.

A number of papers were presented on measurements of dilute solutions of helium-3 in helium-4. J. G. Daunt and C. V. Heer showed that a quasi-gaseous model of a Bose–Einstein liquid can be used to explain the properties of such solutions, without assuming that helium-3 dissolves only in the normal component of the fluid, as has been suggested by K. W. Taconis.

An interesting experiment of a novel kind was discussed by J. R. Pellam. He showed that a Rayleigh disk can be used for investigating 'second' sound; the use of a disk permeable only to the superfluid will give results on the densities of the

normal and superfluid components, the entropy and the specific heat.

Papers on theoretical aspects ranged from the viscosity of gaseous helium-3 and helium-4 (J. H. de Boer) to the hydrodynamics of superfluids (I. Prigogine); the resurgence of physics in Japan was emphasized by a number of papers, read by M. Kotani.

Superconductivity

The session opened with a review by H. Fröhlich of his new theory of superconductivity. The problem of finding an interaction mechanism leading to a new electronic state different from the usual state by a small enough energy has been solved, but it has not yet been possible to show that this will lead to superconductivity. The interaction is between the electrons and lattice vibrations through spontaneous emission and absorption. This differs from that in electromagnetic theory in that the velocity of the particles (electrons) is much greater than that of the waves (phonons). The interaction depends on the ionic mass, and so gives rise to the isotope effect; on the simple theory the transition temperature should vary with the inverse one-half power of the isotopic mass. A new fundamental length of the order of 10^{-5} cm. appears, which may be connected with long-range order effects. M. R. Schafroth described an attempt to show that the theory leads to the London equations, but A. B. Pippard suggested that the true equations might be integral equations with the Meissner effect not implicit but imposed as a condition of the solution. On the experimental side, Pippard pointed out that the sharpness of the transition temperature with a mixture of isotopes implies that groups of at least two thousand atoms be involved simultaneously to avoid a spread due to random variations in the isotopic distribution, while groups of 10^{10} atoms are required to avoid a spread due to temperature fluctuations. This, and the smallness of variations in the penetration depth with magnetic field at constant temperature, suggest that the interactions have a range of the order of 10^{-4} cm. This range might be affected by impurities.

Experimental work on the isotope effect was reported by E. Maxwell, who finds that in tin the transition temperature varies with the power $(-0{\cdot}486 \pm 0{\cdot}031)$ of the isotopic mass, while in lead the power is $-0{\cdot}73$ (M. A. M. Olsen-Baer). A striking result in work on thin films by R. Hilsch is that bismuth condensed from the vapour at 4·2° K. is superconducting, but, after annealing at room temperature, it is not. Among many other papers on superconductivity, mention should be made of a superconducting galvanometer (F. T. Pullan), with a voltage sensitivity of 10^{-12} volt. It is being used to measure the thermoelectric e.m.f. around a tin–lead circuit the junctions of which differ in temperature by only 0·01°. Experimental and theoretical work on the de Haas–van Alphen effect was reported from Cambridge.

Magnetism

In a review of recent advances in paramagnetism, B. Bleaney showed how the use of paramagnetic resonance has made possible the investigation of the behaviour of the ionic energy levels in a magnetic field in a detail which could not be achieved by previous methods. This is particularly valuable in the study of hyperfine structure, since in dilute salts the position of levels as close as 0·001° K. can be determined. This has made possible the analysis of the degree of nuclear alignment by methods such as have been suggested by Gorter and Rose. The information obtained has given impetus to new theoretical work: in the iron group, by Abraham and Pryce, and in the rare earths, by Elliott and Stevens. In the latter case, the use of a crystalline electric field of axial rather than cubic symmetry accords well with the experimental results on the ethyl sulphates. A. H. Cooke described the paramagnetic properties of cerium ethylsulphate, the high anisotropy and low susceptibility of which normal to the crystal axis suggest its use for measurements below 1° K. A magnetic field could then be applied normal to the axis without producing appreciable heating of the salt.

A concentrated attack on the antiferromagnetic state below 4·5° K. in copper chloride was reported from Leyden, measurements having been made on the susceptibility, the paramagnetic resonance spectrum and the nuclear resonance spectrum in a single crystal. The behaviour of the magnetization is in accordance with the theory of Néel, and the effective moment of the cupric ion can be calculated from the nuclear resonance spectrum.

Further measurements on remanence, hysteresis and similar effects in paramagnetic salts at temperatures of the order of 0·01° K. were described by D. de Klerk and M. J. Steenland. It seems that the behaviour observed resembles that of more concentrated salts at higher temperature, being antiferromagnetic in nature. Lack of dependence on the Curie point on shape suggests that it is due to exchange forces rather than magnetic dipole–dipole forces.

After a review of possible experiments with oriented nuclei by M. H. L. Pryce, C. J. Gorter gave a short account of work at Leyden. This has included experiments with gamma-ray emission and the absorption of unpolarized neutrons; one somewhat doubtful positive result has been obtained, the rest being negative. J. M. Daniels reported on work in progress at Oxford.

Two-stage demagnetization experiments using a superconducting wire as a heat-switch were described by J. Hatton. With a starting field of only 9 kilogauss, a temperature of 0·0011° K. has been reached, and the sample remained below 0·01° K. for forty minutes. B. V. Rollin showed that nuclear resonance experiments on a natural crystal of beryl have confirmed the value of 3/2 for the nuclear spin of beryllium-9 from observation of the quadrupole splitting, and a previously unobserved line has been ascribed to silicon-29, with a gyromagnetic ratio of 1·11.

B. Bleaney
R. Bowers

OBITUARY

Prof. F. W. Oliver, F.R.S.

Francis Wall Oliver was born on May 10, 1864, at Richmond, Surrey. On the paternal side he came of a Northumbrian Quaker stock; his great-grandfather, Daniel Oliver (1771–1848), was well known as a preacher among Friends in the North of England. Though F. W. Oliver did not remain a member of the Society, certain traits in his character, such as his unyielding individualism, may perhaps be associ-

ated with his Quaker origin. His father—the third Oliver in direct succession to bear the name of Daniel—was keeper of the Herbarium at Kew during 1858–90, and, concurrently, professor of botany at University College, London, during 1860–88. His official house on Kew Green, where F. W. Oliver was brought up, had been occupied previously by Sir Joseph Hooker. Frank's childhood memories included meetings with botanists whom few now living can recall, such as M. J. Berkeley (1803–89) and Asa Gray (1810–88). In 1871, when he was seven years old, George Bentham (1800–84) gave him the book by Edward Lear which contains the "Nonsense Botany", with its deliciously absurd pictures, closely resembling those in certain medieval manuscript herbals.

Frank Oliver was sent to Friends' schools at Kendal and York, and then, after a period at University College, London, to Trinity College, Cambridge. In those days the best training in research was to be had in Germany, and in 1885 and 1886 his initiation took place under Strasburger and under Pfeffer. Daniel Oliver retired from the professorship at University College in 1888, and F. W. Oliver, though only twenty-four, succeeded him as head of the Department. In this capacity he revealed a breadth of sympathy, which enabled him to draw out the individuality of his pupils, while he also had so wide a range of knowledge that it was possible for him to meet and help each student, wherever his chosen ground might lie. The catholicity of his interest would be difficult to parallel in these days of specialization. He once described how he had, in youth, worked through a whole century of the botanical volumes of the *Annales des sciences naturelles*, adding, as a final comment—"and great fun it was". In his personality, however, it was not the purely intellectual aspect of things that was in the ascendant. His physical hardihood, and the determined keenness of his face—he characterized a certain silhouette of himself as "the old hawk"—marked him as a man in whom thought was the handmaid to action. Among his students half a century ago, it was said that F. W. Oliver was born to be a naval officer rather than a professor. There was a prophetic touch in this dictum, in view of the subsequent naval careers of his two sons—Vice-Admiral Sir Geoffrey Oliver, commander-in-chief, East Indies Station, and Captain (E) P. D. Oliver, R.N. Their father's love for an adventurous outdoor life was fostered in childhood by a glorious year of running wild in Jersey, where his grandparents lived. Later on, it found its outlet in mountaineering. This passion dated from his school days in Westmorland; it was shared by his wife, whom he first met when they were both waiting at Zermatt to climb the Matterhorn. The mountain fervour eventually had to give way to an absorbed pre-occupation with coastal regions, the ecology of which came to play a leading part in his departmental programme.

In the latter part of the nineteenth century, university botany had become predominantly an affair of the laboratory and botanic garden, and there was little organized field-work for students. Oliver once wrote that, in the eighteen-eighties, the 'country' was regarded primarily as a source of 'material' for the stocking of laboratory shelves. It was not, indeed, until early in the present century, when ecology had begun to breathe fresh life into outdoor botany, that an attempt was made from University College to carry out a systematized survey of the vegetation of an individual locality. The pioneer effort took the form of an expedition to the Norfolk Broads in 1903. After this tentative experience, Oliver chose the Bouche d'Erquy, on the north coast of Brittany, twenty-five miles west of St. Malo, as an ecological centre for his Department; the visits paid to it covered the period 1904–9. The primary object of the first year's work was to map and level the physical features and plant-associations, as a basis for further research. In later years a variety of experimental and ecological techniques was employed (*New Phyt.*, **3**, 1904, and later years). A. G. (now Sir Arthur) Tansley, who has since been so largely responsible for the development of ecology in Great Britain, had much to do with the initiation of the Erquy studies. Another ecologist, closely associated with Oliver's vegetation surveys, was E. J. (now Sir Edward) Salisbury, who eventually succeeded him in his professorship. From 1910 onwards, Oliver's ecological activities were transferred to Blakeney Point in Norfolk—an area which has since come under the control of the National Trust (*Trans. Norfolk and Norwich Nat. Soc.*, **9**, 1909–14, and later years). Many of the Blakeney observations find a place in Tansley's work, "The British Islands and their Vegetation" (1939; ed. 2, 1949).

It was not in Oliver's nature to confine himself to the ivory tower of academic botany; he was constantly trying to apply his ecological experience to the needs of man. Evidence of this will be found in two team-work books which he edited—"The Exploitation of Plants" (1917) and "Life and its Maintenance" (1919). Both of these were based on public lectures at University College, dealing with problems the urgency of which emphasized itself during the First World War. Oliver's contribution to the first volume was on the reclamation of waste lands, while, in the second volume, he discussed the use of certain grasses as substitute raw material for paper. In another book, "Tidal Lands" (1918), he collaborated with A. E. Carey, a maritime engineer, in a study of the maintenance of coastal and riparian areas. In this work he describes the part played by plants in fixing dunes, and in reclaiming shingle beaches and salt marshes. He lays special stress upon *Spartina Townsendii*, the grass that he called "a Gift from Heaven", on account of its mysterious origin, and its almost miraculous power of transforming salt marsh mud into land suitable for reclamation. In the autumn of 1950, at the age of eighty-six, he re-visited the Dutch *Spartina* fields, to study the progress they had made since the first batch of cuttings was sent to Holland more than twenty-five years before.

The special courses of lectures, often by outside men of science, which were a feature of F. W. Oliver's Department, and to which I have alluded in connexion with the economic aspect of his work, also gave the opportunity for dealing with other topics not included in examination syllabuses, such as the history of botany. Oliver had inherited and extended his father's collection of old herbals and of the work of botanical draughtsmen, and his interest in the subject found expression in organizing courses on the historical aspect of plant delineation, and of botanical study in Great Britain. Some of these lectures were incorporated in a book which he edited, "Makers of British Botany" (1913).

F. W. Oliver's own personal research had its focal centre in palæobotany. His friend, D. H. Scott,

inspired him with fervour for the subject, and his early enthusiasm was closely linked with a course of lectures which Scott gave at University College in 1896, and which were afterwards published as "Studies in Fossil Botany". Oliver specialized in the complex seeds of Carboniferous plants, and examined modern gymnosperms, such as *Torreya*, to find material in which to trace the phylogenetic history of seed structures. Coal Measure seeds are commonly seen only in detachment from the parent plant, so that, in the early days of these studies, their attribution was conjectural. In looking through the Williamson Collection of sections of Carboniferous plants at the British Museum in 1902, Oliver noticed certain anatomical features which practically proved that the fossil seed, known as *Lagenostoma lomaxi*, belonged to the fern-like plant, *Lyginodendron oldhamium* (now called *Lyginopteris*). He reported what he had seen to Dr. Scott, and asked him to collaborate in an account of this identification. Such a suggestion was natural, since the Williamson Collection was, in a moral sense, Scott's property; in order that it might belong to the nation, he had bought it when the opportunity arose, the British Museum repaying the debt by instalments. Scott, however, held very decidedly that the epoch-making *Lagenostoma* discovery should be published by Oliver independently; but Oliver remained determined that it should be joint work, and he finally prevailed upon Scott to agree. The collaboration was complete; Oliver has assessed their contributions as being "50/50 both in the descriptive and theoretical parts". In their memoir, "On the Structure of the Palæozoic Seed *Lagenostoma Lomaxi*, with a Statement of the Evidence upon which it is referred to *Lyginodendron*" (*Phil. Trans. Roy. Soc.*, Ser. B, **197**, 193; 1904), the name Pteridospermeæ was proposed for fern-like plants bearing seeds; Oliver and his pupils afterwards investigated other members of the group. Scott always accorded the fullest recognition to Oliver's primary part in unravelling the *Lagenostoma* secret; this became strikingly evident when the Pteridosperm nature of *Lyginopteris* was clinched, once and for all, at the Cambridge meeting of the International Botanical Congress in 1930. At this meeting well-preserved impressions of *Sphenopteris hœnighausi* (the foliage of *Lyginopteris oldhamia*) actually bearing cupules and seeds were exhibited by W. J. Jongmans. At the end of the paper, Scott, who was presiding, left the chair, and disappeared quietly from the room, thus compelling Oliver "to take the 'curtain' alone". (See notices of D. H. Scott by A. C. Seward in "Obit. Not. Fellows Roy. Soc.", 205; 1934, and by F. W. Oliver, *Ann. Bot.*, **49**, 823; 1935.) In 1905, the year following the appearance of the *Lagenostoma* paper, Oliver was elected to the Royal Society, and in 1925 the Linnean Medal was awarded to him.

The year 1929 was a turning point in Oliver's career. His marriage in 1896 to Mildred Alice Thompson had given him a home atmosphere of rare and delightful quality, in which all his activities could expand and flourish. The only shadow was the distressing illness of their third child, Faith, who was partially paralysed, and for twenty years required ceaseless care, which Mrs. Oliver gave with unstinted devotion. This invalid daughter died in 1929, and her parents were then free to embark on an entirely different mode of life. Later in that year, Oliver, being then sixty-five, retired from University College, though pressed to continue for a further period. 'Fougasse' marked the occasion by an admirable cartoon, depicting F. W. Oliver soaring into the air, pipe in mouth, from the top of the portico steps of the College, his discarded cap and gown in flight behind him. The drawing was inscribed: "The Boy—What will he become?"—a query which was answered by his appointment in the same year to the professorship of botany in the Fouad I University, Cairo, a post which he held for five years. For the first three winters, Mrs. Oliver was able to be with him at Heliopolis; a vivid picture of their cosmopolitan life there is given in her "Letters from Egypt", printed after her death in 1932.

Even after Oliver had retired from this second professorship, he remained in Egypt, which became more exclusively his home than he had anticipated, since the War put a stop to his annual visits to England. For fifteen years he lived in a house he had built at Burg-el-'Arab in the Western Desert, thirty miles west of Alexandria. There was no irksomeness for him in the remoteness and isolation of his chosen spot; ennui was not within his experience. Many years ago, when he lay ill in a nursing home in the dreary precincts of Fitzroy Square, he replied to a visitor, who had ventured to condole with him on the tedium of this imprisonment: "*Nothing* is boring". Indeed, in Egypt, under the stimulating influence of surroundings not staled by custom, his interests took on a renewed lease of life. One of his special concerns, European coastal problems, suggested lines of approach to certain urgent Egyptian questions. In 1941 he published, under the auspices of the Egyptian Ministry of Agriculture, a paper on "The Sand-Dune Menace", in which he urged long-term planning for the stabilization of wandering dunes. In other articles he dealt with desert dust-storms (*Geog. J.*, **106**, 26; 1945; **108**, 221; 1946). He continued, as ever, to view all manifestations of life with the eye of an artist-naturalist, whether he was describing lyrically the "chromatic symphony" of the Maryut flowers, or with equal pleasure observing a garden plant of *Agave americana*, with a flowering shoot more than 27 ft. high, raining nectar in a wind from its myriad perianth cups, each the size of a small liqueur glass. Again, as occasion served, he recorded the ways of ants, hornets, snails, sparrows, or the larvæ of a psychid moth; or he assembled, for packing material, the resilient balls of *Posidonia* fibres, which the sea cast up in their hundreds; or he collected on his rambles, with discriminating zest, handles of amphoræ, believed to have been imported from the Greek islands in Ptolemaic times, some "still carrying their impressed trade-marks—fresh and bright as the day they left the kiln".

In 1950, after twenty-one years in Egypt, Oliver concluded negotiations for the transfer of his property to the Farouk I University, Alexandria, for use as a field station. He then returned to England, and reinstated himself in his former home, Ballard's Barn, Limpsfield Common. Here the end came with complete suddenness on September 14, 1951.

Throughout his life, Oliver never ceased to observe and to record. Less than a month before he died he sent to me specimens and notes relating to a mutant form of *Salvia horminum*, which had appeared this summer in his garden. To the last he defied time, and looked forward to the enjoyment of yet more flowering seasons; in his eighty-eighth year he declared his intention of planting "3 Magnolias together in an appropriate border".

AGNES ARBER

NEWS and VIEWS

Forestry in the University of Edinburgh : Prof. M. L. Anderson

Dr. M. L. Anderson has been appointed to the chair of forestry in the University of Edinburgh recently vacated by Prof. E. P. Stebbing. Dr. Anderson, who already holds a doctorate of the University, brings to his new post a wide experience of British forestry, having served first in the Forestry Commission, both as a district officer and as a research officer, and then in Eire, where he was director of forestry for the period 1940–46 and had to deal with the practical and administrative problems connected with the severe war-time shortage of timber and fuel. In December 1946 he joined the Imperial Forestry Institute at Oxford, where he was responsible for instruction and research in forestry mensuration and British forestry practice. Dr. Anderson has a wide reputation as a sylviculturist with special knowledge of the native hardwoods of Britain, particularly the oaks, to which he has devoted a great deal of outdoor and literary research ; his most recent publication is a very detailed study of the status of the sessile oak in the New Forest, and his alleged partiality for this species has long been the subject of friendly chaff. Another pronounced preference shown in his work and writings is for an uneven-aged structure of woods and group regeneration, and he has done much to collect experimental data bearing on the matter. His recent publication on the choice of species in relation to site factors is an important contribution to the literature of the subject and reveals a wide knowledge of this leading aspect of the vast afforestation task in Great Britain. His translation of Tamm's work on "Northern Coniferous Forest Soils" illustrates another task he has frequently undertaken, that of making available to the English-speaking forester the published material and views of leading foreign workers on subjects of importance to Great Britain. Dr. Anderson is one of the few British foresters for whom Swedish, and even Russian, present no serious difficulty. As a contribution towards the investigation of another of the major current forestry problems in Britain, during his time at Oxford Dr. Anderson undertook a study of the relation between the State and private forestry in the Western democracies. Dr. Anderson's appointment at Edinburgh is a very appropriate recognition of the large share he has taken in the advancement of knowledge and thought in the field of forestry, and the effects on the coming generation of his teaching and his example in his new post are likely to be far-reaching.

Education in the University of Edinburgh : Sir Godfrey Thomson

Sir Godfrey Thomson, who retired this year from the chair of education in the University of Edinburgh and from the directorship of Moray House Training College, has made a distinctive contribution to the theory and practice of mental testing. On the theoretical side, he has been a critic of the bold generalizations of Spearman and others, and his work on sampling and the influence of selection upon the factors in a correlational matrix stresses the need for caution in this field. On the practical side, Sir Godfrey has made Moray House the major British centre for the provision of intelligence tests in schools. He has also been concerned with population trends and a possible decline in our national intelligence. His Galton Lecture in 1946 dealt with this topic. He was chairman of the committee which carried out the Scottish Mental Survey of 1947, and is continuing his researches on the data which that survey provided. Sir Godfrey has also achieved notable success as a teacher, and the contribution made to educational and psychological research by his pupils is very great. There are at present no less than ten professors of education or psychology who have studied under him.

Prof. J. G. Pilley

Prof. John G. Pilley, who succeeds Sir Godfrey Thomson, is a Londoner who graduated in natural science in the University of Oxford in 1922. After three years as a research physicist, he became a university lecturer in education at Liverpool for a year and then, from 1926, at Bristol. In 1937 he went to the United States by invitation of the Rockefeller Trustees and Columbia University to study the teaching in American schools and to help in formulating proposals for the reform of the teaching of science. On the outbreak of the Second World War he was prevailed upon to take charge of the Department of Education at Wellesley College, Massachusetts, the post he now relinquishes. Though a man of science, and a successful teacher of science, it is in the philosophy of education that Prof. Pilley's interest is centred. He stands by the values embodied in the educational tradition of classical liberalism against every form of facile modernism. He has made his mark in America as a vigorous critic of the tendency to make education 'scientific', holding that this means, in effect, to anchor it to values that are shiftingly pragmatic, and often ephemeral. His published writings, though slight as yet and mostly topical, have a quality and direction which suggest that he has an important contribution to make to educational theory ; perhaps, in particular, to the solution of that most urgent contemporary problem, the effective integration of science in the theory and practice of a liberal education.

F. M. Balfour (1851–82)

Born in Edinburgh a century ago, on November 10, 1851, Francis Maitland Balfour, a younger brother of the statesman Arthur James Balfour, was one of the most distinguished of British zoologists and embryologists of his time. At the age of twenty-two he did original work at Cambridge on obscure points in the development of the chick, and at the Zoological Station in Naples, under Anton Dohrn, he elucidated the embryonic history of the Elasmobranchs, which was then little understood. This latter research, published in the *Quarterly Journal of Microscopical Science* (1873–75), won him a fellowship of Trinity College, Cambridge, and a lectureship on animal morphology in the University. His classical "Treatise on Comparative Embryology" (two vols., 1880–81), a masterly digest of the previous knowledge on the subject and embodying his own original contributions, was instantly recognized by his fellow scientific workers. In the graphic words of his teacher, Michael Foster, it "brushed away many cobwebs and mooted points with a firm but courteous sweep", and it laid the foundation of the modern study of descriptive embryology. Balfour's numerous honours included the fellowship of the Royal Society in 1878, one of the Society's Royal Medals three years later, and the professorship of animal morphology in the University of Cambridge, which was created for

him in 1882. For several years he was one of the editors of the *Quarterly Journal of Microscopical Science*. In the summer of 1882 Balfour went to Switzerland to recuperate from an attack of typhoid fever. He and his guide were killed, probably on July 19, while attempting to climb a virgin peak on Mont Blanc. His tragic death at the early age of thirty-one robbed the world of science of one of its most imaginative, original, attractive and promising workers.

Institute of Navigation : Medal Awards for 1951

THE Gold Medal for 1950–51 of the Institute of Navigation has been awarded to H. C. Pritchard for valuable contributions to navigation made over a number of years in the field of airborne navigation equipment. In 1939 Mr. Pritchard formed the Navigation Section at the Royal Aircraft Establishment, and it was in a large measure due to his personal guidance that practical solutions were found to many of the air navigator's problems. Mr. Pritchard's team successfully developed the distant-reading and gyro-magnetic compasses, the air mileage unit, air position and ground position indicators, the drift recorder, the astrograph and the astro-compass. Later during the War, Mr. Pritchard was given responsibility for the formation of an experimental unit to deal with problems of blind approach and landing, and important advances were made in the art of all-weather flying.

Bronze Medals, for the best paper to be published in any year in the Institute's *Journal*, have been awarded to R. F. Hansford (development of ship-borne navigational radar), C. S. Durst and N. E. Davis (jet streams and their importance to air navigation), and Captain F. J. Wylie, R.N. (ret.) (radar and the rule of the road at sea).

Lord Cherwell, P.C., F.R.S. : Paymaster-General

ON July 5 in the House of Lords, Lord Cherwell made a vigorous attack on the way in which research on, and development of, atomic energy was being conducted in Great Britain. Lord Cherwell has now been appointed to the office of Paymaster-General in the new Government headed by Mr. Winston Churchill, and has been made responsible for the supervision of research and production in connexion with atomic energy, and also for the Prime Minister's statistical branch. It is worth recalling some of the points made by Lord Cherwell in the House of Lords debate. He referred to the impending retirement of Lord Portal from the post of director of atomic energy, and urged a complete change of organization. Civil Service methods, he said, were inadequate for the task, and the scientific men and engineers required were not forthcoming because they hesitated to commit themselves in a service where their work would always be subject to Civil Service administration. He asked for the transfer of work on atomic energy from the Ministry of Supply, which hitherto has been responsible for it, "to a special organization under the direct control of the head of the Government". His present appointment suggests that Lord Cherwell will now be able to put his views into practice, though such drastic changes in the control of a large body of scientific workers and others must clearly take a little time. Since he has a seat in the Cabinet and he is to have an office at 11 Downing Street, he will have easy access to the Prime Minister. Lord Cherwell is a man of energy and determination, and can be counted upon to see that atomic energy research and development in Great Britain receive the attention so vital a subject warrants.

Rockefeller Grant for Chemistry in the University of Oxford

THE Rockefeller Foundation of New York has made a grant to the University of Oxford of £10,000, to be expended over four years, for the Dyson Perrins Laboratory in aid of research in organic chemistry sponsored or directed by the Waynflete professor of chemistry, Sir Robert Robinson. The chief topics of such investigations at the present time are : (1) degradative and synthetic studies of alkaloids, plant colouring matters, and certain other natural products ; (2) study of the lipins of tubercle bacilli, especially the fatty-acid constituents ; (3) isolation of a differential growth-inhibiting factor present in malt and wheat-middlings ; (4) synthesis of steroids other than cortisone (this latter is covered by a grant from the Nuffield Foundation) ; (5) general studies of organic chemical reactions.

The Battelle International Institute

THE Battelle Institute, Columbus, Ohio, the well-known American industrial research foundation, proposes to establish an international industrial research institute to serve European industry, on a non-profit basis, through science and technology. The new body, to be known as the Battelle International Institute, will establish research investigations in existing research institutes of Europe and in European universities and technical schools. It will also operate its own laboratories on the Continent. As with the parent organization, financial support for these activities will be derived from industrial sponsorship, from endowment, and from income from patents owned by the Battelle Institute. It will conduct research in the fields of applied chemistry and physics, metallurgy, fuels, ceramics, electronics, theoretical and applied mechanics, the engineering sciences and agriculture. Mr. John S. Crout, for many years assistant director of the Battelle Institute, has been appointed executive director of the new Institute.

Cultural Anthropology of the Rodiyas of Ceylon

THE Rodiyas of central and southern Ceylon are a primitive tribal group, fifteen hundred strong, who have become partly incorporated in Sinhalese society as a caste of drum-makers and beggars. A brief account of them by M. D. Raghavan, "Cultural Anthropology of the Rodiyas" (Ethnological Survey of Ceylon, No. 1 : *Spolia Zeylanica*, **26**, Pt. 1, December 1950), is the first of a series of studies of the lower castes in Sinhalese society to be undertaken as part of the Ethnological Survey of Ceylon. It describes Rodiya myths of origin ; habitat and village organization ; daily life, crafts and methods of begging ; rites at birth, marriage and death ; and peculiarities of Rodiya dialect. Suggestions are offered for Rodiya education and for their further assimilation into Buddhist society. Of interest is the Rodiya myth of descent from Navaratne Valli, a Sinhalese princess who lost her caste through eating human flesh, and the comparison drawn between this mythical ancestress and the Kerala goddess Bhagavadi.

Catalogue of Kenya Timbers

THE Government of Kenya has published a "Catalogue of Kenya Timbers", prepared by S. H. Wimbush, of the Forest Department (pp. 69 ;

Nairobi: Government Printer, 1950; 2s. 6d.). The author gives a brief description of Kenya Colony, with an area of 219,700 sq. miles, of which only one-third has a soil and climate suitable for normal human habitation. The south-western third of the Colony is made up of the Highlands, about one-tenth of which, that is, about 6,500 sq. miles, is believed to be forest. Although the climate of the Highlands is of a tropical nature, it has widely different extremes ranging from the alpine flora of snow-capped Mount Kenya to semi-tropical rain forest in the Lake Victoria basin. There are then two main divisions of forest in the Highlands: mountain forests which are made up of rain, coniferous, bamboo, and semi-evergreen forests; and semi-tropical rain forests. In addition, there are the lowland or coast forests comprising low and rain forest, lowland dry forest and lowland savanna woodland. Brief notes on the characteristics of these forest types are followed by a few general notes on Kenya timbers. Finally, there are indexes to botanical, English and trade names, and to native names with the botanical equivalents. The main purpose of the handbook is achieved, the trees mentioned being given alphabetically with the following details: local names, distribution, frequency, the timbers and uses. Handbooks of this type are invaluable to all forest officers working in tropical areas.

Industrial Microscopy

An exhibition of "How Industry is Using the Microscope" has been arranged by the Royal Microscopical Society (Industrial Section), to be held on November 21 in the Great Hall, British Medical Association House, Tavistock Square, London, W.C.1, by kind permission of the British Medical Association. The exhibition will be opened by Mr. A. J. Philpot, director of the British Scientific Instruments Research Association, at 2.30 p.m., and will remain open until 9.30 p.m. Some forty exhibitors are taking part, including research associations and university departments as well as the research departments of a number of industrial firms and the Department of Scientific and Industrial Research. The exhibits cover a wide range and can be classified as concerning: mining and power; metallurgy; glass and ceramics; paint; paper, rubber and fabrics (including leather); photography; food and agriculture; pharmacy; biology. The various modern forms of optical microscopy are represented in addition to electron microscopy. Apparatus and techniques of general and special application are being demonstrated as well as surface profile techniques for electron microscopy. The exhibition is well illustrated by photomicrographs and electron micrographs. It is open to all, and the catalogue of exhibits and further information can be obtained from the Assistant Secretary, Royal Microscopical Society, Tavistock House South, Tavistock Square, London, W.C.1.

Royal Society of Edinburgh: Officers

Office-bearers and members of council of the Royal Society of Edinburgh have been elected as follows: *President*, Prof. James Kendall; *Vice-Presidents*, Prof. Arthur Holmes, Prof. W. O. Kermack, Prof. E. T. Copson, Prof. J. H. Gaddum, Sir Robert Muir and Prof. James Ritchie; *General Secretary*, Dr. J. E. Richey; *Secretaries to Ordinary Meetings*, Prof. J. Norman Davidson and Dr. John E. Mackenzie; *Treasurer*, A. W. Young; *Curator of Library and Museum*, Dr. Douglas Guthrie; *Councillors*, Prof. T. Neville George, Prof. J. W. Heslop Harrison, Dr. C. E. Lucas, Prof. M. G. Say, Prof. W. M. Smart, Prof. J. F. Allen, Prof. A. Murray Drennan, Dr. E. Wyllie Fenton, J. M. Ross, Prof. C. M. Yonge, Prof. N. Feather and Sir Godfrey Thomson.

Announcements

Capt. Cyril Diver, director-general of the Nature Conservancy, is to retire next autumn. A small committee under Sir Arthur Tansley, chairman of the Conservancy, is considering the problem of finding a successor to Capt. Diver.

Mr. S. S. C. Mitchell has been appointed controller of guided weapons and electronics in the Ministry of Supply, in succession to Air Chief Marshal Sir Alec Coryton. Mr. Mitchell, who is forty-nine years of age, will be in charge of all work in research, development and production of guided weapons in Britain. He will also undertake responsibility for the direction of the Ministry of Supply's work on electronics research, development and production.

Dr. A. H. Bunting, who held until recently the post of chief scientific officer with the Overseas Food Corporation (see p. 804), and who was responsible, from the inception of the groundnut scheme in Tanganyika in 1947, for the agricultural research services there, has been appointed to the Research Division of the Sudan Ministry of Agriculture. He is to be in charge of a new research station for investigating the agricultural potentialities of the central rainlands area of the Sudan. Dr. Bunting was trained at Johannesburg and Oxford (as Rhodes Scholar for the Transvaal, 1938) and has held appointments at Rothamsted Experimental Station, and with the Human Nutrition Research Unit of the Medical Research Council.

The Department of Scientific and Industrial Research (Charles House, 5–11 Regent Street, London, S.W.1) is holding an international symposium on the organization of scientific and industrial research, which will take place in London during November 12–15. All sessions will be held in the Council Room, Lancaster House, London, S.W.1, with the exception of the third session, on "Sponsored Research", which will be held at the National Physical Laboratory, Teddington. Representatives from the following countries will be attending the symposium: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Sweden, Switzerland and the United States.

The Science Section of the Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. has arranged a meeting to be held in the Anatomy Theatre, University College, London, W.C.1, on November 16 at 7 p.m. on "Some Aspects of Biological Research in the Soviet Union, 1948–1951". The chairman is Dr. Sidnie Manton, and other speakers are: Dr. A. Morton on "The Role of Environment in Plant Development"; Dr. R. Trim on "Enzymes and the Living Cell"; Dr. D. Ross and Mr. D. Newth "On Animal Embryos and Cells"; Prof. J. D. Bernal on "Relation between Living and Non-living Matter". Tickets of admission (1s.; S.C.R. members 6d.) can be obtained from the Society, 14 Kensington Square, London, W.8. It is hoped that this meeting may lead to regular annual surveys of Russian work in specific fields.

RESEARCH AND DEVELOPMENT IN BRITISH COLONIES, 1950–51

TO those annual reports of research and development in British Colonies which were last year collected under the title "Colonial Research" there have now been added reports for 1950–51 from the Tsetse Fly and Trypanosomiasis Committee, the Colonial Fisheries Advisory Committee and the Director of the Anti-Locust Research Centre. The present omnibus volume covering 1950–51* thus includes, besides these three reports, the annual report of the Colonial Research Council, the eighth annual report of the Colonial Products Research Council, the seventh annual report of the Colonial Social Science Research Council, the sixth annual reports of the Colonial Medical Research Committee and of the Committee for Colonial Agricultural, Animal Health and Forestry Research, and the fourth annual reports of the Colonial Insecticides, Fungicides and Herbicides Committee and of the Colonial Economic Research Committee. The broad background against which all this work is carried out and a general picture of the work itself is contained in the earlier report, "The Colonial Territories (1950–51)" (see *Nature*, October 20, p. 691). The present report gives the fuller details which the scientific worker expects, together with the particulars of membership of the several councils and committees and lists of publications.

Appended to the report of the Colonial Research Council is a list of research schemes—including fifty-seven new schemes and some sixty supplementary ones made during the year—and of the grants allotted from Colonial Development and Welfare funds. The total of £2½ millions is the highest annual figure recorded, and brings the grant for research schemes since 1940 to about £10¼ millions. After deductions for unspent balances, etc., the net expenditure and commitment on March 31, 1951, was about £9·6 millions, of which slightly more than £9·3 millions is chargeable against funds provided by the 1945 and 1950 Acts, and to this must be added some £2 millions provided by Colonial governments or industry. The actual disbursement of £1,406,651 during the year is the highest recorded, and indicates that major schemes which have been hampered in their progress by scarcity of scientific personnel, labour, building material and equipment are now getting well under way. About 31·5 per cent of the gross allocation has been for agricultural, animal health and forestry schemes, 14·4 per cent for fisheries research, 13·7 per cent for medical research, 11·9 per cent for tsetse and trypanosomiasis research, 8·4 per cent for social science and economic research, 6·3 per cent for insecticides research, 4·6 per cent for research sponsored by the Colonial Products Research Council, 3·3 per cent for anti-locust research and 5·9 per cent for miscellaneous schemes. Major schemes approved during the year were £150,000 for the establishment of the West African Trypanosomiasis Institute and its maintenance for five years; a further £134,745 for the West African Fisheries Research Institute; £135,000 capital expenditure for the establishment of the East African Medical Survey and Filariasis Research Unit; £126,048 for the East African Institute of Social Research for five years; £200,000 for the maintenance for five years of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization; £280,000 for the establishment and maintenance for five years of the East African Central Trypanosomiasis Research Institute; £263,000 for the East African Veterinary Research Organization; £217,228 for the promotion of agricultural research in Northern Rhodesia; and £260,000 for the establishment of a Marine Fisheries Research Station in Singapore.

Commitments against the £13 millions for Colonial research schemes allotted from the additional funds made available by the 1950 Colonial Development and Welfare Act reached approximately £8·3 millions by the middle of 1950, and in December 1950 the Colonial Research Council recommended that the balance should be apportioned between the various fields of research as follows: general reserve, £425,000; agriculture, animal health and forestry research, £1,300,000; work sponsored by the Colonial Products Research Council, £200,000; anti-locust research, £100,000; insecticides (including fungicides and herbicides) research, £550,000; tsetse and trypanosomiasis research, £425,000; fisheries research, £475,000; medical research, £600,000; social science research, £325,000; economic research, £100,000; and miscellaneous research (including industrial and engineering), £200,000. The Council also endorsed a proposal of the Colonial Office that the various research committees and councils should be asked to make recommendations as to the most profitable use of their funds apportioned to their respective fields to meet all new money required during the next five years, including provision for the research of important schemes.

The Scientific Council for Africa South of the Sahara has now been duly established, with Dr. P. J. du Toit as chairman and Dr. E. B. Worthington as secretary-general, and held its first meeting at Nairobi during November 1950. During the year an American hydrologist and engineer were engaged to survey flood conditions on the Kafue Flats in Northern Rhodesia, and a malacologist was secured to investigate the schistosome-transmitting snails in West Africa. A fourth scientific worker has been assisting in locust research at Cambridge. A further survey was made by the African Studies Branch of the Colonial Office of racial differentiation in the laws of all the African territories, and arrangements have been made for the reproduction of a bibliography of published sources relating to land tenure in the South-East Asia and Pacific Colonial territories compiled by the Colonial Land Tenure Advisory Panel. The report of the Colonial Building Research Liaison Officer on his visit to Africa in the autumn of 1949 has been endorsed generally by the Council. The report emphasized the need for encouraging the better use and improved manufacture of local materials and more economical building design. Problems which require urgent study include the behaviour of materials in tropical climates, the development of material manufactures and methods of construction suitable for African conditions, the

* Colonial Office. Colonial Research 1950–51: Reports of the Colonial Research Council, Colonial Products Research Council, Colonial Social Science Research Council, Colonial Medical Research Council, Committee for Colonial Agricultural, Animal Health and Forestry Research, Colonial Insecticides, Fungicides and Herbicides Committee, Colonial Economic Research Committee, Tsetse Fly and Trypanosomiasis Research Committee, Colonial Fisheries Advisory Committee, Director, Anti-Locust Research Centre. (Cmd. 8303.) Pp. 243. (London: H.M. Stationery Office, 1951.) 6s. 6d. net.

design of buildings for comfort in hot climates, and low-cost housing for the African urban population. Research is also needed into the penetration of moisture through building materials and the fortification of native materials to resist insect and mould attack. A manual relating to the protection of buildings and timber against termites has been published. A census was held in Bermuda during October, and in Lagos in February, 1950. Recruitment of staff for the Directorate of Colonial (Geodetic and Topographic) Surveys made progress, and field survey work was maintained mainly in Africa, where the Royal Air Force continued air-photography in East, Central and West Africa. Mapping increased and considerable progress was made in the investigation of mineral deposits. Some fifty-two additional geologists, geophysicists and chemists were appointed during the year, and the universities are now being asked to extend their interest in Colonial geological research. In meteorology the principal development has been the progress towards a West Indies Meteorological Service, covering the West Indian Colonies and the Bahamas, with its headquarters in Trinidad (see also *Nature* of November 3, p. 769); but progress has also been made in the programme of *radiosonde*/radar wind stations and the facilities they will provide for the study of upper-wind conditions. The Colonial Road Research Liaison Officer visited Kenya, Uganda, Tanganyika and Zanzibar during September–October 1950. A report on this visit will shortly be issued. This visit has led to the conclusions, among others, that the more technical road problems of East Africa are broadly similar to those of West Africa, but are aggravated by the greater prevalence of poor-quality soils and roadstones, and that research on Colonial soils and roadstones, and indigenous materials such as *karkar*, coral, soda, wood-tar, and agricultural wastes, and to determine the minimum thickness and quality of road suitable for Colonial conditions, is urgently needed.

The report of the Colonial Products Research Council again consists of a general part and a more detailed review of some research work in progress. Much attention has been given to the fermentation of the cocoa bean, and it has been established that the predominant species of yeast in cocoa beans commercially fermented in Trinidad and Grenada is *Candida krusei* (A. Cast.) and that *Saccharomyces* species never represent a significant percentage of the total yeast microflora. The observation that the chocolate flavour develops after drying and roasting if aseptic ripe pods are left for some days in dilute solutions of either acetic acid or sodium acetate (but not citric or phosphoric acid) at 48° C. may prove of immediate industrial value. Work on the antibiotic 'comirin' is continuing, particularly with the view of utilizing it as a fungicide or in the protection of paper, canvas and paints. The Colonial Microbiological Research Institute has also investigated the red root disease of West Indian limes and the artificial cultivation of the edible mushroom, *Volvaria esculenta*, *Bresadola*, and at the University College of the West Indies Prof. C. H. Hassall and Miss L. Wong have shown that the antibiotic, monamycin, separated from a strain of Meredith's actinomycete, is not identical with musarin.

In the work at the University of Birmingham under Prof. M. Stacey more attention has been directed to the action of bacteria on sugar and other carbohydrates. Prof. Stacey's observation that ultrasonic sound waves can degrade the highly polymeric dextran obtained by the action of bacteria on sugar to give the blood plasma substitute previously prepared by acid hydrolysis has been applied in a completely new manufacturing process for this substance. The structures of various ethylidene derivatives of *d*-mannitol have been elucidated by G. T. Bruce, and a series of trifluoroacetyl derivatives of amino-sugars possessing unusual properties prepared by Dr. C. M. Tatlow are being further investigated. A detailed study of sugar-cane wax isolated from the filter muds of all the sugar estates in the West Indies is being made in collaboration with Prof. L. F. Wiggins, of the Imperial College of Tropical Agriculture, Trinidad, and a method for the purification of the wax is being tried on a pilot-plant scale, as is a method for the manufacture of lactic acid. A high grade of cellulose has been obtained by Prof. Stacey by the action of bacteria on sugar, molasses and effluents containing sugar. The examination of the pharmacological action on the nervous system of sugar derivatives prepared by Prof. Wiggins and his collaborators indicates that, with one exception, the seventy pyridazone derivatives screened are unlikely to be suitable for clinical trial. In Prof. Stanley Peat's laboratory at the University College of North Wales, Bangor, the complex system of enzymes involved in the metabolism of starch in the higher plants has been further studied.

Considerable progress has been made in the study of the thermal polymerization of drying oils, and the study of the component glycerides in *Stillingia* oil has been completed, as well as some further studies on deca-2 : 4-dienoic acid and its derivatives. Trials in different areas in Australia have demonstrated the marked effect of climatic conditions on sunflower seed oils, and sufficient information has now been obtained from the experimental plots to justify the Director of Agriculture, Nigeria, starting the cultivation on an area of two hundred acres of the vine, *Tetracarpidium conophorum*, the oilseeds from which provide the conophor oil in which the paint industry is interested; but although the prototype machine for decorticating candlenuts (*Aleurites triloba*) gives a satisfactory separation of shells and kernels, the latter are damaged to an extent which renders them unsuitable for export. Work has continued on plants of possible medicinal and insecticidal value: a study of the essential oil from the wood of *Brachylæna hutchinsii* has been completed, and the structure of the phenol, chlorophorin, present in *Chlorophora excelsa* wood established. Experiments on the purification of the germination factor for *Striga hermonthica* have been actively pursued at the Universities of Leeds and Cambridge. Examination of samples of the oleo-resin from *Pinus caribæa* (British Honduras) have shown that the oil of turpentine and resin are of excellent quality.

The seventh annual report of the Colonial Social Science Research Council estimates that a little more than £100,000 remains available for the next five years for new projects and contingencies in this field. While recruitment of junior research staff improved, difficulty is still being experienced in recruiting sociologists qualified to undertake field demographic studies and urban surveys, and senior men for appointments of two or more years. Special efforts have been made to associate the staff of university colleges in the Colonies with the work of the institutes of social and economic research. Besides the organization by University College, London, of anthropological investigations in the Jos

Plateau and Cross River areas, the two studies of the social structure of an Indian community in Fiji and of the development of social welfare services in Tonga (sponsored by the Research School of Pacific Studies of the Australian National University) and the social science research financed by the University of Malaya and the University College of the Gold Coast, some social science projects have been sponsored by Colonial governments without assistance from Colonial Development and Welfare funds. Research into the grammar and structure of the Somali language, for example, has been carried out by the Director of Education, Somaliland Protectorate; the Tanganyika Government has employed three sociologists, who were to investigate land usage and associated problems in the highland areas of the Northern Province, make a two-year intensive study of the Sukuma tribe, and also a study of the Makere tribe of the Southern Province. The Government of the Gold Coast has financed further research into the teaching of English and into customary land tenure in the northern territories, while the Institute for Medical Research, Malaya, has made studies into the social and economic factors in food consumption, in conjunction with clinical and dietary investigations into malnutrition. The Ethnographic Survey of Africa by the International African Institute has made considerable progress; the survey of the Northern Bantu linguistic border was nearing completion and two sections of the survey of the languages of Africa (Berber languages of North Africa and languages of West Africa) were in the press. Besides brief notes on various socio-economic, ethnographic and anthropological studies in progress in Africa, in South-East Asia and the Pacific and the Caribbean, including also some investigations on psychological testing, the report includes as appendixes reports on work of the Institute of Social and Economic Research of the University College of the West Indies, the West African Institute of Social and Economic Research, which began operations in October 1950, the East African Institute of Social Research, which started work in May 1950, and the Rhodes–Livingstone Institute; appendixes also deal with research under the auspices of the University of Malaya and with research in social sciences at the University College of the Gold Coast and in education at Singapore. The policy and proposed programme of research of the West African Institute are given in full.

All the main schemes under the Colonial Medical Research Committee continued during 1950–51; but the sixth annual report again records inadequate recruitment. Only £600,000 was available from Colonial Development and Welfare funds for continuance of these and for the initiation of new schemes up to 1956, and the programme is under review in the light of this allocation. The Filariasis Research Unit established at Mwanza, Tanganyika, has now been fully staffed and has extended its surveys of filarial infections in the area. Studies on the chemotherapy of bancroftian filariasis have confirmed the high tolerance of the African for doses of the piperazine derivative, 'Hetrazan'. Investigations on loiasis in the Cameroons continued, and in south-west Nigeria a study of the ecology of the local species of *Cyclops* (the copepod crustaceans dwelling in ponds and streams which serve as intermediate hosts to the guinea worm) and a survey of the infection in the area have been commenced. Reasonably good results were obtained in the first twelve months of an experiment in the control of malaria in four valleys in Negri Sembilan, Malaya, in which all houses in one valley were sprayed with DDT, in another with 'Gammexane', while in a third proguanil was distributed weekly to the population. Studies of the effectiveness of DDT and 'Gammexane' against Malayan mosquitoes have also been made, while in North Borneo, besides studies of the repellent effect of DDT to *A. leucosphyrus*, the entomological, spleen and parasite surveys required for the Tambunan experiment to determine whether malaria can be controlled by the localized clearing of jungle growing over *A. leucosphyrus* breeding places has continued. Malaria research in Jamaica has been directed chiefly to the study of the habits and infectivity of suspected malaria vectors, mainly *Anopheles albimanus*, and the distribution of anopheline bites among different human age-groups in relation to general problems of malaria transmission and epidemiology; in Trinidad investigations on outside-resting *A. aquasalis* were intensified, and others on the relative attraction of various animals for *aquasalis*, night activity and ecological studies of various types of breeding places were started. An investigation of the natural history of malaria in African infants in Nigeria was concluded, and comparative field trials on three groups of 245 African school-children naturally infected with *P. falciparum*, *P. malariæ* and *P. ovale* showed that all malario-metrical indices decreased more rapidly in the chloroquine than in either the mepacrine or the proguanil groups.

Neither a director nor adequate scientific staff have yet been secured for the West African Virus Research Institute, Lagos, but at the East African Virus Research Institute, Entebbe, Uganda, a long-term programme of research on rickettsioses, with special emphasis on tick-typhus, has been commenced and research on the epidemiology of yellow fever has continued. Further work on the preparation of specific precipitin sera for the identification of blood-meals of insects was carried out at the Lister Institute, London, and the scrub-typhus field research unit of the Institute for Medical Research, Malaya, has completed a general survey of potential mammalian hosts and trombiculid mites, which has shown that the common giant rats (*R. sabanus*, *R. müller*) of the Malayan forest are the proper hosts of the vector-species group of mites, while the stream- and gulley-infesting species *R. müllerei* is the chief host of *Trombicula deliensis* itself in the forest. The Field Research Station, Fajara, Gambia, is now better placed to conduct its investigations into causes of ill-health and inefficiency among the rural African population and on measures likely to alleviate or eradicate them. In Malaya clinical trials of thiacetazone against leprosy are well advanced, and in Nigeria, following a study and assessment of the value of sulphone treatment, an attempt is being made to develop a simple, cheap and effective form of sulphone treatment suitable for wide use in such countries as Nigeria.

In the sixth annual report of the Committee for Colonial Agricultural, Animal Health and Forestry Research reference is made to the work under the East African Agriculture and Forestry Research Organization with systemic insecticides against rosette disease of groundnuts. Although initial infection was not prevented, the aphids carrying the virus were killed. Work on the sudden-death disease of clove trees has shown that the disease is due to more than one cause and in young clove trees is largely caused by a new and undescribed species of

Cryptosporella, which is also responsible for a high proportion of dieback in mature trees. Besides research on animal trypanosomiasis and particularly on 'Antrycide', research has been carried out on lapinized rinderpest virus. At the West African Cacao Research Institute, Tafo, investigations are proceeding into the diseases and pests of cacao, the agronomy of the crop, the breeding of improved types and problems of cocoa fermentation. At Rothamsted a survey of the occurrence of aluminium in the plant kingdom, including every family of flowering plant and vascular cryptogams, has shown that very strong accumulators of this element are confined to twenty, and moderately strong accumulators to twenty-eight, families.

Fuller space is given in this report to the work being undertaken by the Colonial Departments of Agriculture, Forestry and Veterinary Services, among which may be mentioned the investigations in British Guiana into the causes of loss in fertility of the 'pegasse' soils of the north-west, the study in the Gold Coast on the dieback disease of lime, and plant-breeding work in Kenya with wheat, maize, sorghum, barley and oats to produce disease-proof varieties of improved yield and commercial qualities, and in Tanganyika on coffee. The survey and collection of varieties of paddy have continued in Malaya, and the discovery in New Guinea of a tachinid parasite of the banana scab moth, *Nacoleia octasema* Meyr., offers the possibility of a biological method of controlling this pest. In Jamaica further work has been carried out on tick dip-fluids for cattle; besides cattle-management studies in Uganda, extensive field trials have been made of a copper preparation for seed disinfestation, and these have given promising results in the control of blackarm disease of cotton. Reports from the standing Sub-Committees for Cocoa Research, Soils and Stored Products Research are also included.

The fourth annual report of the Colonial Insecticides, Fungicides and Herbicides Committee, to which is appended an outline of the work of the Committee during 1947–50, emphasizes the high standard of the work of the Colonial Insecticides Research Team at Porton. The studies on aqueous suspensions of DDT particles in different size-ranges have yielded results which are important for the control of other insect pests besides adult mosquitoes, with which the work has already been done. An inverse relation has been established between particle size of insecticides and their initial contact-toxicity to mosquitoes and a similar relation between particle size and fumigant effect, and the work has been extended to include its effect on the persistence of volatile insecticides with the view of determining formulations giving the maximum initial and residual toxicity. Besides the sorption of solid insecticides by dried mud-blocks, a study has been made of the contact-toxicity to mosquitoes of deposits from aqueous suspensions of inert dusts impregnated with insecticides from other solutions. Promising results have been obtained in the incorporation of insecticides in resin surface coatings, and one containing 20 per cent DDT prevented for several months the fouling by barnacles of marine underwater wooden surfaces. At Silwood Park a detailed study was being made of the structure of insects to determine the mode of action of residual deposits, and also of the way in which insecticide particles are picked up by insects when moving over treated surfaces, while studies at Rothamsted have shown that at 110° F. DDT is rapidly lost by volatilization from crystalline deposits and that the presence of wax has little effect on the contact-toxicity of the glass plates. Final assessment of the results of the trials on the application of insecticides by aircraft against the tsetse fly is not yet possible, but under certain conditions and against certain species almost complete elimination of the tsetse population of a given area appears possible, although whether the method is economically feasible has yet to be proved. It has been necessary to abandon for the time being the project for establishing a West African Insecticide Research Unit. Final results on the treatment of African huts at Kasanje and Mbale, East Africa, for control of mosquitoes and malaria indicate that BHC applied at three-monthly intervals is the best insecticide to use.

The Colonial Economic Research Committee records in its fourth annual report that the study of the national income of Nigeria was initiated in the autumn of 1950, and a survey of the available data relating to Colonial dependence on imported foods has been completed. Arrangements were made in March 1951 for a pilot investigation of the value of sample market surveys as an aid to the promotion of industrial development in the Colonial territories. It is hoped to recruit suitable economists to undertake studies of the retail trade in Tanganyika, Nyasaland and Zanzibar and of capital investment in the Colonial territories generally.

The report of the Tsetse Fly and Trypanosomiasis Research Committee for 1950–51 is prefaced with some notes on the origin and past activities of the Committee. Its work on insecticides has now been taken over by the Colonial Insecticides, Fungicides and Herbicides Committee; and, when the Committee was reconstituted in 1949 and the directors of the East African Tsetse and Trypanosomiasis Research and Reclamation Organization and of the West African Institute for Trypanosomiasis Research were invited to join, the terms of reference were slightly amended and made to read as follows: "To consider and advise on the co-ordination of action, including research and reclamation, directed against human and animal trypanosomiasis".

Considerable progress has been made in studying the relation of the tsetse to its environment, and new techniques were being developed. Plans were being formulated for three schemes of experimental practical reclamation work, one in each of the East African Territories, and interesting results have been obtained in conjunction with the East African Veterinary Research Organization, with a programme of monthly and two-monthly prophylactic injections of 'Antrycide'. Close interest has been taken in the antimonial and arsenical compounds discovered by Dr. F. A. Friedheim for use in human trypanosomiasis, and, following satisfactory results with melarsen, further trials will be carried out.

The Colonial Fisheries Advisory Committee's report on Fisheries Research for 1950–51 refers to the almost complete lack of trained and experienced research workers which has delayed implementation of the research programme. A good supply of candidates for fisheries research studentships to be awarded in 1951 became available, however, and from 1952 the staff situation should be easing. At the Inter-territorial Fisheries Research Station at Jinja, on Lake Victoria, an intensive study of the growth of the phytoplankton has been started as well as of the identification and life-histories of snails and of

their parasites, and on growth-rates and breeding of several species of fish. Research at the West African Fisheries Research Institute was about to begin.

The report of the Director of the Anti-Locust Research Centre on locust research and control for 1950–51 reviews the advisory activities of the Centre, which are chiefly connected with regional anti-locust organizations, as well as that of the Desert Locust Control Executive Committee, and with the research being carried out on the taxonomy of locusts and grasshoppers, field investigations on the behaviour of adult desert locusts and on methods of control. Extra-mural researches mostly fall in four overlapping groups: three of them, namely, those investigations in biochemistry, physiology or behaviour which relate to phase phenomena, phenomena migration or to population dynamics, are only just beginning; the fourth group relates to the destruction of locusts by insecticides and machinery. A 20 per cent solution of dinitro-*o*-cresol has proved very effective for aircraft work, but baiting remains the principal method of control.

TECHNIQUE OF ELECTRON MICROSCOPY

CONFERENCE AT ST. ANDREWS

THE Electron Microscopy Group of the Institute of Physics held a conference in St. Andrews University during June 19–21, which was attended by about eighty scientific workers. On the first day three symposia were held: recent experiences in the cutting of thin sections; critical testing of instrument performance; and replica techniques. This was followed by a few short original papers. The second day was entirely devoted to the reading and discussion of papers.

M. S. C. Birbeck opened the session on section cutting by discussing modifications to be made in histological technique in order to cut sections thin enough for electron microscopy. Embedding and fixation were particularly dealt with, as it is in these preparative processes that the main difficulties now lie; the actual cutting of suitably prepared blocks is no longer a matter of special difficulty. The modified Cambridge rocking microtome will cut to 0·2 μ, and some Continental makers are producing instruments to cut even thinner sections than this.

It is desirable to embed the tissues in a harder medium than usual, and Mr. Birbeck favours 'ester wax', though Dr. C. E. Challice prefers the purer diethylene glycol distearate, and Prof. L. H. Bretschneider uses a wax mixture including carnauba wax. Fixatives which are suitable for optical preparations may fail for electron microscopy because they precipitate the protein in a fine form which shows spurious structure in the electron microscope size-range. There are exceptions, however, and the most successful fixatives for this purpose are those based on osmic acid and potassium dichromate. A tmann's mixture is specially recommended.

Dr. C. E. Challice opened the discussion and was in general agreement with Mr. Birbeck's methods, differing principally in the knife-blade he uses and in methods of removing the ester wax from the section when cut. Birbeck sublimes the wax in the electron beam itself, but Challice finds that this leaves a 'fixed' residue and prefers to warm the specimen *in vacuo* before exposing it to the beam.

Dr. J. Nuttings's paper opening the session on replica techniques was read for him by Dr. A. F. Brown. After ten years of development, the electron microscope is beginning to give results of real value to metallurgists; and this is happening, not because of special advances in technique and resolving power, but because of the accumulation of experience and data from the use of plastic replica techniques at moderate resolving power and magnification.

Comparison of dry-stripped 'Formvar' replicas with optical micrograms of the identical areas of the surface (made possible by a method developed by E. D. Hyam) show that at least in the optically resolvable range these replicas are completely reliable. Dr. G. L. J. Bailey, in discussion of this paper, expressed the opinion that the biggest problem before the electron microscopist in the metallurgical field is to persuade the classical metallurgist to accept his results; but he was able to cite instances where the electron microscope has proved trustworthy when the conventional optical methods have given misleading results.

Replica methods giving higher resolving power than the simple plastic replica are available or are being developed, but cannot compete with the speed and ease of the dry-stripped 'Formvar' process. Such are the method of polymerizing a monomer *in situ* to form an intermediate cast (in a two-stage process), and, as J. B. Le Poole mentioned, the use of an evaporated silver intermediate cast with silicon monoxide for the final replica, which is said to have a grain size of atomic dimensions and give maximum resolution. The resolution of the simple plastic replica, also, can be improved by preshadowing the metal surface; but there is sometimes difficulty in stripping the shadowing metal, and the discussion showed that the conditions under which this occurs are not understood. A paper by A. W. Agar and R. S. M. Revell, read later in the conference, discussed plastic replicas of ferrous specimens, and suggested that, though the major features are reliably pictured, some fine detail, especially on ferrite grains, is probably spurious and due to the etching process.

The basis of interpretation of replicas of some chromium-nickel steels was broadened by Dr. J. F. Brown and D. Clark, who isolated particles of sigma-phase electrolytically and investigated their crystal structure by electron diffraction (of individual particles selected from the electron microscope field). Correlation of the particle shapes with features of the replicas was possible. J. Trotter has observed two intermediate nitride phases in alpha-iron in addition to the well-known Fe_4N.

The interesting work of Drs. I. M. Dawson and V. Vand on spiral growth of crystal faces, particularly of the paraffin *n*-hexatriacontane (see *Nature*, **167**, 476; 1951) was reported to the meeting, and one or two points of general interest to electron microscopists emerged. Gold-manganin is mobile in the electron beam on a paraffin surface and therefore cannot be used as a shadowing metal; palladium is satisfactory for this purpose. The graphitization of the paraffin in the beam is not instantaneous, and paraffin electron-diffraction patterns can be observed for about five minutes before they degenerate into diffuse rings. There was some discussion on the stability of these materials in the beam, and it seems that chemical structure is at least as important as

melting point in determining their resistance; thus a paraffin of melting point 74° C. may be quite stable, whereas an aromatic hydrocarbon of melting point 200° C. may polymerize.

A spongy growth of silica in a furnace containing zirconium silicate bricks was shown by Mr. G. A Bassett to be in the form of long fine filaments, each of uniform diameter in the range 100–600 A. This curious form of growth appears to be associated with the vapour phase, as a similar growth of silicon filaments is observed in the action of silicon tetrachloride on zinc. In the case of the silica the X-ray picture shows the filaments to be vitreous.

S. F. Ward reported an instability of siliceous material in the electron beam, having observed that the diatom *Synedra fulgens* shrinks by 5–10 per cent in length on first exposure in the microscope, though after this it becomes stable. The striation spacings in this diatom show a coefficient of variation of up to 9 per cent, so that if it is to be used for magnification calibration it must first be stabilized and then calibrated optically over the identical region used in the electron microscope observations.

H. L. Nixon has extended the method of concentration estimation by particle counting, first described by Williams and Backus, by using tomato bushy stunt virus instead of polystyrene latex as his standard reference particles. The sprayed droplet size is kept small so that a trace from an evaporated drop is only 2–3 μ in diameter and can be photographed entire at a sufficient magnification to enable one to distinguish bushy stunt virus from other particles in the 10–50 mμ range, while the number of bushy stunt particles can be large enough to give adequate statistical accuracy from counts of only a few traces.

Some experiences of the effect of salt in the purification of vaccinia virus were reported by Drs. C. E. Challice and A. S. McFarlane. Slow flocculation by sodium chloride of a well-washed preparation gives very clear and sharp virus particles as seen in the electron microscope, but similar treatment of less well-washed material results in a non-removable fine granular deposit becoming attached to the virus bodies.

Dr. R. Reed described some work, carried out in Prof. W. T. Astbury's laboratory at Leeds, in collaboration with Dr. L. Hoyle, on the human influenza virus. Ether treatment causes the virus bodies to break down into smaller particles, which form two groups, one showing antigenic activity and the other agglutination properties. It is suggested that the virus-replicating units may be small protein macromolecules which later aggregate to form the virus elementary bodies. Dr. Reed also mentioned work on fibrous components of the human skin, and showed slides illustrating the changes in collagen and elastic tissue in various pathological conditions. Subcutaneous lesions in rheumatoid arthritis have been examined, and the collagen shown to be partly degraded in the intermediate regions and reduced to debris in the badly diseased regions. Preliminary findings on the action of adrenotropic hormone (ACTH) and cortisone on the fibrinoid regions of the diseased tissue were also touched upon.

Work on the cell wall of *Staphylococcus aureus* by Dr. I. M. Dawson and H. Stern makes it very probable that this is of a polysaccharide rather than a protein nature. The apparent disappearance of the cell walls of the intact cells when the organisms are treated with cetyl trimethyl ammonium bromide (CTAB) is ascribed to swelling of the cytoplasm into such intimate contact with the enclosing wall that the latter is no longer separately distinguishable.

The problem of sterilization of film-covered electron microscope grids, before inoculation with slow-growing organisms, has been solved by R. W. Horne by exposing them to ultra-violet radiation; this does not damage the thin nitrocellulose or 'Formvar' film.

The stages of development of the spermatozoon of the spider beetle *Ptinus tectus* were described by Drs. J. Długosz and J. W. Harrold. The mature sperm is unusual in having neither a head nor a nucleus in the ordinary sense; it is of filamentous form, with the hereditary material distributed along the central axis.

Dr. H. J. Woods, with S. M. Mukherjee and J. Sikorski, following the work of Rånby and Ribi, have examined the products of sulphuric acid disintegration of various cellulose textile fibres and find very similar elongated tablet-shaped particles in each case, though the dimensions (20–40 A. thick by 80–160 A. wide) vary somewhat from fibre to fibre. This represents a disintegration beyond the more familiar fibrillar state. Similar tablets are obtained from mercerized materials. Films made by depositing the tablets from suspension show a preferred orientation of the 101 planes parallel to the surface, and the density of such a film is greater than that of the native cellulose of the original fibre, as would be expected if the particles represent the more highly crystalline portions of the cellulose.

The session on critical testing of instrument performance was opened with a lecture by M. E. Haine. Low resolution may often be due to some coarse and easily detected defects, like stage drift or electrostatic charges. Removal of these more obvious faults may still leave a lack of resolution, and Mr. Haine gave a list of possible causes and the means of their detection. Thus, astigmatism can be detected by observing zinc oxide crystals, or, if less prominent, by the observation of the Fresnel pattern near the focus, as used by Hillier, etc. For the most exacting requirements, the Fresnel fringe test with coherent illumination, as described by Haine and Mulvey, can be applied. Mr. Le Poole mentioned his method of locating charged-up areas by forming images of them on the observation screen. Lens current and high-tension variations can be determined from the change in the electron diffraction pattern.

Dr. H. J. Woods and J. Sikorski read a short paper on the filament life in the Metropolitan-Vickers *E.M.*3 instrument. They have found an average life of 15 working hours (at 75 kV.), but filament life appears very dependent on the experience of the operator. J. B. Le Poole and A. C. van Dorsten described a short focal-length objective. From certain theoretical considerations they have found that an objective of 0·8 mm. focal length (at 80 kV.) should be possible. Experiments with soft-iron pole-pieces have confirmed this, giving the predicted focal length. Slightly more favourable dimensions can be obtained with cobalt–iron pole-pieces. The advantage of such a short focal-length objective is its low chromatic aberration, which reduces the requirement for voltage and current stabilization.

A paper on the performance of high-voltage electron guns, as used in electron microscopes, was read by M. E. Haine and P. A. Einstein. It was shown that for a wide range of electrode geometries the theoretical limit of brightness, as predicted by D.

Langmuir, can be achieved if suitable bias-voltages for the shield electrode are chosen. The geometry of the gun is only important in determining the most economical working conditions, that is, lowest total current for maximum brightness.

Dr. G. Liebmann discussed magnetic projector lenses. The focal length of all symmetrical projector lenses can be represented by one single curve. All lenses can be operated at a point where they are free from radial distortion. Calculations agree well with Ruska's measured data. Certain results of use in practical lens design were combined by Dr. Liebmann in a design chart. Dr. C. E. Challice described a modification of the projector lens of the RCA *B*-type electron microscope, which turns the two-stage instrument in effect into a three-stage one, by replacing the standard pole-pieces of the projector lens by a double-gap pole-piece insert. In this way the usable range of magnifications can be greatly increased. A similar modification has been carried out by Dr. J. F. Brown and D. Clark on their Metropolitan-Vickers *E.M.*2 instrument. They added a further excitation coil and replaced the existing pole-piece insert by a double-gap insert, adding also a diffraction diaphragm.

Dr. G. L. Rogers gave a talk on "The Elements of Diffraction Microscopy". He reviewed the principles of Gabor's proposals, and pointed out that each 'hologram' can be considered as a zone plate. Thus a definite focal length $\pm f$ can be ascribed to each hologram. f determines the image position, whereas the magnification of the 'reconstruction' follows from geometrical considerations.

D. G. Drummond
G. Liebmann

MEDICAL EDUCATION IN TURKEY

ONE of the articles (which is written in English) by Prof. F. Nafiz Uzluk in the latest issue of *Acta Medica Turcica* describes the present state of medical education in Turkey (3, No. 1–2; June 1951).

The old medical education of the Moslem Turks living in Anatolia was based on the medical teaching methods of Jundi Shahpur, as it has been in other Moslem countries. According to this system of teaching, students were required to finish their primary and secondary education in privately owned medresses (religious schools or seminaries). After this they were sent to hospitals to get medical experience by familiarizing themselves with various diseases by the bedsides of patients. That was the general procedure to acquire both practical and theoretical knowledge in order to become a physician. At the end of his training a successful student who had proved his ability was granted a diploma.

Some individuals were fortunate enough to continue their studies in sciences other than medicine; these sciences were classified as theological, juridical or technical. If, in addition to medicine, a student could also continue his studies in one of these fields, he was granted the title of professor or judge. He also obtained the privilege of teaching in one of the medresses.

During the period of the Ottoman Empire, which lasted six hundred years, some of the Turkish physicians held offices as Kadies of Cairo or Istanbul or as military Kadies of Anatolia and Rumeli. Among them some were appointed as the grand religious leader (Sheyhullislam).

Suleyman the Magnificent, or the Law Giver, the Turkish Sultan who ruled in the sixteenth century, had built the famous mosque which was named after him with eight medresses surrounding it. One of these medresses was devoted to medical teaching, and each year eight students were awarded scholarships. In the records of a charity foundation these students are described as "danissments", a word corresponding to what is now called "assistant". In the same record are the words "muit", an Arabic word corresponding to associate professorship, and "muderris", corresponding to the full professorship of to-day.

The medical institute built by Suleyman the Magnificent lasted until 1860. Here a large number of physicians were trained and sent to many different parts of the Turkish Empire. In 1827 the Turkish Military Medical School was founded. In this institution at the beginning the teaching language was Italian, but later French was accepted in its place. This school lasted until 1909. The graduates served in the Army with appropriate ranks.

To make studies easier, in 1866 the Turkish language was accepted instead of French. In the same year another medical school was opened for civilians. These two schools continued in separate buildings until they were brought together in 1909 and a bigger institution came into being at Istanbul. The Medical Faculty of the University of Istanbul developed from this school.

Besides these schools, a surgical school was opened in Istanbul in 1831. This institution also provided many surgeons for the Turkish army and later was combined with the Military Medical School, which is still functioning.

In 1945 a new medical faculty was founded in Ankara as a part of the University. At present there are two medical faculties, one in Istanbul and the other in Ankara. The duration of studies before graduation is six years; entry is open to all without discrimination of any kind provided the candidate has reached the necessary standard of general education.

In 1951, 150 students were accepted by the medical faculty at Ankara; at present the general enrolment consists of 1,048 young men and 218 women. During 1945–50, 534 doctors graduated from the medical faculty of the University of Ankara, which thus provides an average of more than a hundred doctors a year.

At Istanbul, more than four hundred medical students graduate each year.

At present there are 7,349 medical men in Turkey. As the total population of the country is twenty-one million, 2,857 people are served by each physician. Besides the medical schools at Ankara and Istanbul there are two other advanced schools. One is the School of Dentistry, founded in 1909, and the other, the School of Pharmacology, founded in 1879. The duration of studies in these schools is four years.

In order to practise medicine and pharmacology in Turkey, a person must either graduate from one of the institutions described or from one of the well-known foreign faculties. Doctors of other nationalities are not allowed to practise medicine in Turkey, but some professors and specialists of foreign origin are given special permission; although they are not allowed to practise, they may be invited for medical consultations by Turkish medical men.

After further training a graduate of one of the medical faculties may specialize in one of the following branches: in internal diseases; surgery; neurology and psychiatry; gynæcology; pædiatrics; diseases of the ear, nose and throat; diseases of the eye; dermatology; neuropathology; urinary diseases; orthopædics; biological chemistry; pharmaceutics; microbiology; physio-therapeutics; anatomical pathology; radiology and radiotherapeutics; hygiene and medical jurisprudence. After acquiring both practical and theoretical knowledge and after passing a recognized examination he may become a specialist.

Besides this article the journal contains others in English, French and German. *Acta Medica Turcica* is owned and controlled by the Ankara University Medical Faculty and is edited by a Board appointed by the Council of the Faculty. It is devoted to the publication of original observations and investigations in various fields of medicine, and is published four times a year.

UNIVERSITIES OF GREAT BRITAIN

FINANCIAL AND POPULATION STATISTICS FOR 1949–50

THE publication entitled "Returns from Universities and University Colleges in receipt of Treasury Grant for the Academic Year 1949–50"*, issued by the University Grants Committee, is arranged in general on the same lines as in previous years, but a smaller format has been adopted. A new table gives for each university and university college comparative figures of income and expenditure in the year 1949–50 and the previous year. The chief features of the returns are the record number of students (85,421, compared with 83,690 in 1948–49), the continuing high proportion of assisted students (62,199 or 72·8 per cent, as against 61,655 or 73·7 per cent in 1948–49 and 55,539 or 70·7 per cent in 1947–48) and the increased dependence on Parliamentary grants, which represent 63·9 per cent of the recurrent income as against 59·2 per cent in 1948–49 and 57·8 per cent in 1947–48. There was again a welcome increase in the ratio of staff to students, the full-time teaching staff increasing by 540 to 7,930. The increase in staff was made up chiefly of 35 professors, 26 readers, assistant professors or independent lecturers, 126 senior lecturers and 329 lecturers.

Of the full-time students, 68,605 were reading for a first degree, 9,459 for a diploma, and 7,357, together with 4,080 of the 17,660 part-time students, were engaged in research or other advanced work; 63,157 full-time students were in England, 5,284 in Wales and 16,980 in Scotland; of these, 15,309 were at Oxford and Cambridge, 17,499 at London and 30,349 at other English universities and university colleges. Increases in numbers at the individual universities were not in general large, and there were small decreases at King's College, Newcastle upon Tyne, the Universities of Liverpool and Nottingham, Manchester College of Technology, University College of North Wales, Bangor, and the Universities of Aberdeen and Edinburgh. The proportion of full-time students residing in colleges and halls of residence was 22·8 per cent, as against 25·1 per cent in 1938–39, in spite of the substantial amount of new residential accommodation brought into use since the War, although the number in residence is greater (19,458 as against 12,555); 39·3 per cent were in lodgings and 37·9 per cent at home, the corresponding figures for 1938–39 being 33·2 and 41·7 per cent, respectively. There was a slight increase in overseas students compared with 1948–49: 3,387 full-time and 1,580 part-time students came from within the British Commonwealth, while a further 2,677 full-time and 1,316 part-time students came from foreign countries; these figures compare with 2,857 full-time and 658 part-time Commonwealth students and 2,356 full-time and 999 part-time foreign students in the last year before the War. Of the 24,331 students admitted for the first time in 1949–50 (a decrease of 495 on 1948–49), 21,574 were reading for a first degree and 2,757 for a diploma, and of those reading for a first degree 13,519 were nineteen years of age or more.

The distribution of students differed little from that in 1948–49, 43·6 per cent being in arts, 19·8 per cent in pure science, 16·6 per cent in medicine, 12·8 per cent in technology, 3·2 per cent each in agriculture and in dentistry and 0·8 per cent in veterinary science. Of the full-time advanced students, 37·7 per cent were in arts, 36·3 per cent in pure science and 12·9 per cent in technology. Only in agriculture was there a decrease in numbers (146) during the year, the increases in the remaining groups being arts 96, pure science 818, medicine 429, dentistry 177, technology 49, and veterinary science 308; 286 of these last were due to the incorporation of Glasgow Veterinary College into the University of Glasgow. Of the full-time students, 50,039 out of 66,068 men and 12,160 of 19,353 women, or 72·8 per cent of the total, were receiving assistance in the way of scholarships, exhibitions or other awards from public or private funds. The percentage for England as a whole was 76·2, for Wales 83·7 and for Scotland 56·7, compared with 76, 81·8 and 62·9 per cent, respectively, in 1948–49. For the provincial universities the figure (79·5) was intermediate between those for Oxford (82·2) and Cambridge (78·6), but higher than that in the University of London (66·9) Of the part-time advanced students, 45·1 per cent were in medicine and dentistry, 32·3 per cent in arts, 10·8 per cent in pure science and 10·8 per cent in technology.

The recurrent income of the universities and university colleges in the year under review amounted to £22,009,735, an increase of £3,853,157 on the previous year, parliamentary grants totalling £14,056,436 and representing 63·9 per cent of the total as against 59·2 per cent in 1948–49. Income from fees increased to £3,898,809, from endowments to £1,253,784 and from grants from local authorities to £1,008,128, but were only 17·7 per cent, 5·7 per cent and 4·6 per cent, respectively, of the total as compared with 20·6 per cent, 6·7 per cent and 5·0 per cent in the previous year; for England these percentages were 17·5, 5·8 and 4·8, respectively, for Wales 16·7, 2·1 and 6·9, and for Scotland 18·9, 6·3 and 3·0. The total income for English universities was £17,604,807, of which £6,348,424 was for the University of London, £2,003,845 for Cambridge, £1,566,547 for Oxford, £1,057,990 for Manchester, £940,779 for Durham and £914,963 for Birmingham. The total income for the University of Wales was £1,064,105 and for Scotland £3,340,823.

* University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant for the Academic Year 1949–1950. (Cmd. 8307.) Pp. 38. (London: H.M. Stationery Office, 1951.) 1s. 6d. net.

Of the total expenditure of £21,799,958, an increase of £3,777,864 on the previous year, administration accounted for 8·8 per cent, departmental maintenance 68·2, maintenance of premises 10·8, and miscellaneous expenditure 10 per cent. Capital expenditure met from reserves totalled £472,327, and allocation to reserve £270,993. Departmental maintenance included salaries of teaching and research staffs and payments for superannuation, the running costs of laboratories, lecture rooms, libraries and museums, and the supply of materials, apparatus, books, specimens, etc. Salaries and superannuation amounted to £10,546,346, and departmental and laboratory maintenance £3,272,900, as compared with £8,185,763 and £2,854,845 in 1948–49. Library expenditure, which amounted to £788,402, an increase of £155,147 on the previous year, is analysed in a separate table which shows that of this total £416,604 was for salaries and wages, £182,595 on account of books and £95,867 on periodicals. These figures all show increases on those for the previous year; while the percentage of university expenditure on libraries was still only 3·7 as against 3·4 in 1948–49, eleven universities, Oxford (£25,688), Cambridge (£13,969), Manchester (£8,499), Birmingham (£7,922), Liverpool (£6,022), Glasgow (£10,924), Edinburgh (£9,671), Aberdeen (£6,320), London (£5,806), Reading (£5,068) and Leeds (£5,778), as well as the London School of Economics (£5,515) and the School of Oriental and African Studies (£5,024), spent more than £5,000 on the purchase of books. Of these, Cambridge (£9,601), Glasgow (£7,421) and Oxford (£6,683) also spent more than £5,000 on periodicals.

PERSONNEL MANAGEMENT

IN a recent broadsheet published by the Institute of Personnel Management, G. R. Moxon examines the functions of a personnel department in an industrial undertaking.

The personnel department is a division within the management structure wherein men and women are employed to help to evolve and carry out the various policies of a company in matters affecting its employees. Following current industrial practice, the work of a personnel department is described under six headings: employment, wages, joint consultation, health and safety, employee services and welfare, and education and training.

There is, however, no model or standard personnel department because industry itself is so infinitely varied. British industry is largely made up of companies employing less than a hundred persons. No specialized department is necessary for so small a unit and, in all probability, one personnel officer, responsible to the head of the business, may adequately cover the normal personnel duties arising from the employment of anything from 250 to 500 employees. From 500 to 1,000 employees, personnel problems assume greater proportions and make desirable the employment of a personnel officer. The large industrial unit, and the combine in particular, employing more than a thousand persons, has a wide variety of personnel problems which call for degrees of specialization among members of its personnel department. In those companies, whether medium-sized or large-scale, where personnel management is an accepted practice, there is general recognition that the functions of the personnel department can be grouped into the six divisions already mentioned.

Personnel policies in industrial organizations are the concern of directors or principals. It then becomes the responsibility of management to see that policies are translated into good management practices so that the spirit and intention of policy are faithfully carried out. The personnel department, where it exists in an organization, is a specialist department used for helping the directors in their policy-making and assisting management in carrying out what has been agreed.

Personnel management in Great Britain has evolved from a 'welfare' origin. In its earliest days it may have meant little more than the good intentions of an owner who put what he felt into practice by occasional acts of benevolence or generosity. Welfare officers were first employed in a few of these 'enlightened' companies until the problems of the First World War brought about a considerable increase of similar appointments. A majority of these war-time appointments were terminated with the return of peace-time competition.

It was not until the middle thirties, following upon the serious employment and social problems which followed in the wake of periods of slump and depression, that the establishment of an employment and welfare department began to interest an increasing number of managements. Progress was relatively slow since, for economic and other reasons, the majority of employers were reluctant to regard the labour problems of management as worthy of special study and attention. Personnel management grew principally in the new industries where employers were keen to attract and maintain a stable and efficient working force, as well as in the old-established companies where employers brought a human outlook to bear on matters affecting their employees.

As a result, personnel management had won a firm place in the management organization of a number of industries before the Second World War and, during the War, as the human problems of management again assumed immense proportions, the number of personnel departments increased more than four-fold. Since the War this growth has been maintained.

The problems which confront personnel managers to-day are the improvement of factory relations to the point where national aims and the common interest of management and men may be realized, provision of the right climate of incentive for harder and better work, and making the best use of individual, or group, ability. The techniques employed by personnel managers in tackling these problems are elaborated by Mr. Moxon. Yet though these techniques are the methods by which industry seeks to promote more fairness and justice in factory life and to secure more efficient production, the will to do these things, the good intentions or principles, are as fundamental and as important as they were to the early pioneers. What makes the task more formidable is the knowledge that better management practice of to-day requires a full understanding and a greater measure of support from workpeople and their union representatives, the majority of whom have long memories and are not yet convinced that job security ultimately depends on taking every opportunity to increase production, improve quality and reduce costs.

Other topics considered by Mr. Moxon in this thoughtful and carefully ordered broadsheet are the relation of the personnel to other factory departments and the way in which a personnel department might be organized.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Resistant Peripheral Membranes of the Keratin Fibres

In a number of communications, Alexander and Earland[1-3] have claimed to have isolated from wool a new morphological component, a highly resistant continuous membrane lying between the usually recognized cortex and cuticle. In collaboration with Happey[4], they have further claimed to have demonstrated that the new component is a β-type protein, that is, allied in molecular structure to stretched hair, silk, etc., and that this β-type molecular structure accounts for the stability and resistance of the membrane.

The existence of a subcuticular membrane in animal hairs was suggested by the German workers Lehmann[5,6] and Elöd and Zahn[7] several years ago. Their evidence for a subcuticular origin for the tubular residues has already been criticized and the tubes shown to be derived from the *external* layers of the scaly cuticle, that is, to be cuticular sheaths[8]. To cite merely one convincing experiment: tubes were prepared from fibres which had previously been coated superficially with a thin metal layer by evaporation *in vacuo*. The isolated tubes were found to bear the metal layer which unambiguously labelled the outside surface of the cuticle[9]. Alexander and Earland have merely provided further evidence for a general rule that when the keratin fibres are brought into solution a resistant residue remains which consists of the tubular membranes enclosing a variable quantity of fibrillar cortical fragments[10].

The reason for the separation of the tubes as coherent forms is found by electron microscopy, which shows that the walls of the tubes consist of a very thin, extremely resistant membrane reinforced to a variable degree by the adhesion of granular protein[8,11]. This thin resistant membrane can be separated in a purer condition by chlorinating wool, when the membrane is inflated as small bubbles (Allworden sacs) and can be rubbed off in fragments by shaking in water[8,12]. This latter experiment is evidence of the external location of the new membrane, which is seen to form an epicuticle, a thin layer uniformly enveloping the fibre much as if it had been lacquered. This epicuticle is indeed a new morphological component and may be a further example of the peculiarly resistant membranes which electron microscopy has revealed in animal tissues. The epicuticle of hair appears to be chemically the most resistant component of the fibre and remains when the keratin proper is dissolved. Since a certain amount of the rest of the cuticle always adheres to it, we have the possibility of forming more robust sheaths or external casts of the scaly layer, and it is these which mistakenly have been thought to come from beneath the scales.

Some preparations of these sheaths give X-ray patterns of diffuse haloes with β-type characteristics as Happey and others have noted, but one is certainly not justified in concluding from this that the tubes are a β-protein and that wool is molecularly a polyphase structure. No β-reflexions in original wool were noted by Astbury and Woods[13], although a β-protein, had it been present to the extent of 7–10 per cent, would have been detected. It is well known[13], however, that after certain chemical treatments causing fibre contraction, a β-structure does develop due to modifications in the cortex of the fibre[14]. An electron microscopic examination of the residue prepared by the method of Alexander and Earland shows, in fact, a considerable quantity of cortical material, which after the chemical treatment it has suffered may be expected to give a β-pattern. In the absence of cortical impurity the tubes give only a most diffuse X-ray pattern from which little can be deduced.

In view of the above criticisms, it may seem unnecessary to comment on the final speculation that the β-structure is the reason for the insolubility of the tubes. Bamford, Hanby and Happey[15] have advanced the hypothesis that the β-structure of certain synthetic polypeptides is the cause of the insolubility of these compounds. There is, however, a considerable difference between synthetic polypeptides and natural proteins, and it is surely better to consider the solubility of actual proteins having a β-structure. We find, in fact, that these are more easily brought into solution than wool keratin; for example, silk in acid or cuprammonium solution and feather in reducing solutions. The suggested explanation is not, therefore, acceptable.

The histological structure of the tubes (epicuticle plus cuticular remnant) shows that the real reason for the separation of the tubes as coherent forms is the insolubility of the epicuticular fraction. The composition of the epicuticle is thus the main problem, and the great difficulty here is to separate it in a pure form and in quantity sufficient for analysis.

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The purpose of Dr. Mercer's communication seems to be to establish the following points: (*a*) that the material isolated by Alexander and Earland is not a subcuticular membrane; (*b*) that the β-protein contained in their material is not present in the initial fibre; and (*c*) that the insolubility of their membranes is not connected with the β-structure.

As regards (*a*) we have no special comment, although we feel that Mercer's view is probably correct. On the other hand, Mercer's arguments against the presence of 7–10 per cent of β-keratin in wool are far from convincing. It is by no means certain that this amount of (partially disoriented) β-keratin, even if it were crystalline, would be detected by X-ray analysis. In fact, Ambrose and

Elliott[1] have shown that in the keratin of elephant hair there is about 10 per cent of the β-form; this is not visible on an X-ray photograph. On point (c), we believe that Mercer's views are unsound. While it is true that the β-protein silk may be more easily dissolved than wool keratin, this difference is not connected with the backbone configuration of the proteins, but results from the presence of cystine cross-links in the wool. Once these are broken, the resulting material dissolves readily in faintly alkaline solutions, for example, very dilute ammonia. Further, on converting the soluble α-keratin to the β-form, there is a marked decrease in solubility. Finally, recent investigations[2] have shown that the α-form of silk fibroin is readily soluble in water whereas the β-form is insoluble.

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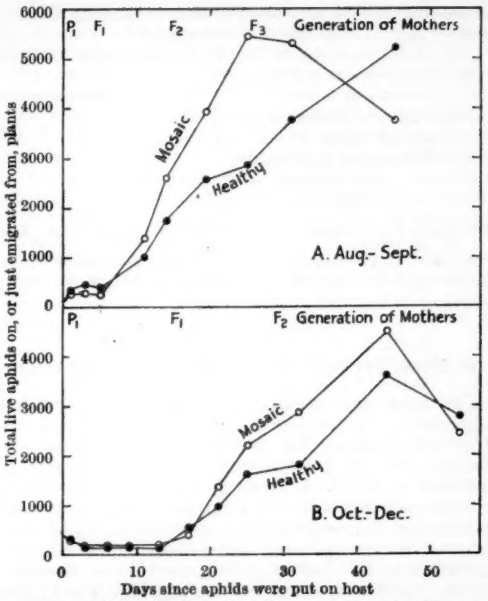
Benefits to Aphids from Feeding on Galled and Virus-infected Leaves

It has been shown that robust green leaves which have ceased growth and not yet entered upon senescence are unsuitable, by comparison with growing or senescing leaves, for colonization by *Aphis fabæ* Scopoli and *Myzus persicæ* (Sulzer)[1-3]. Abnormally extended growth or premature senescence-like changes, or both, are characteristic of both the 'pseudo-galls' (curling and pocketing of leaves) and the virus diseases which plants can develop as a result of aphid attack. Experiments were therefore undertaken to see whether such pathological changes in the plants might not be beneficial to the aphids initiating them.

The yellow-red pocket galls formed by *Cryptomyzus ribis* on red currant leaves were tried first because the galled parts remain soft enough for the pockets to be pushed inside out, thus turning what were the best sheltered into the most exposed parts of the leaf surface. The aphids, which before were mostly inside the shelter of the pockets, were now all removed from the leaves. The leaves were washed, and fresh aphids released on their morphologically upper surfaces. The majority of the aphids settled down to feed again on the galled parts of the morphologically lower surface, although these parts were now convex instead of concave, and were often facing upwards instead of downwards owing to the deformation caused by everting the galls. The aphids' other preferences—for shade from the light, and for a vertical or upside-down posture—could still be detected by comparing their densities on otherwise similar leaf areas. But their preferences for the morphologically lower surface and especially for the galled parts of the leaves were more powerful. When the galls are in their normal uneverted state, the shade and posture preferences will, of course, help to get the aphids into the pockets; but they are evidently of subsidiary importance. Cage experiments confirmed that the aphids multiplied faster where they preferred to feed. So it seems that even such simple 'pseudo-galls' can be physiologically beneficial to the insects causing them, which will be a factor in the evolution of both.



Development of *Aphis fabæ* populations on sugar beets with, and without, mosaic virus disease. *A*, five plants of each kind, mosaics inoculated eighteen days before aphids put on; *B*, four plants of each kind, mosaics inoculated twelve days before aphids put on

The effect on *Aphis fabæ* of feeding on sugar beets with the mosaic disease caused by a virus this aphid transmits was recorded both in free infestations developing on whole plants for several weeks, and in small cages on individual leaves for 1–4 days. The population on diseased whole plants grew distinctly faster than on healthy plants in both experiments (see accompanying graphs). As a result, overcrowding and emigration also began sooner in the former population. Given fresh plants available for the emigrants to colonize and infect, however, the rising part of the curves should be repeated, and the beneficial effect of the disease should continue exponentially. The confirmatory experiments on individual leaves involved, in all, four batches of diseased plants, some seven thousand adult apterous viviparous aphids caged in groups of ten or twenty, and some twenty-five thousand of their offspring. The average output of young per mother caged on leaves showing mosaic symptoms (systemically infected, following sap-inoculation of the plants 11–240 days before the experiment) was compared with the concurrent output of young on leaves of similar age on uninfected plants of the same batch. The output was higher on the mosaic than on the healthy leaves in twelve out of thirteen experiments on growing leaves, in eight out of nine experiments on mature leaves and in three out of three experiments on senescing leaves. The ratios between the two outputs, mosaic / healthy, from all twenty-five experiments, gave a mean of 1·41 with a standard error of 0·062. Evidently the disease renders the whole plant, and not merely the mature leaves, more suitable for this vector. The epidemiological and evolutionary consequences, for both virus and vector, invite further attention; so also, from the point of view of plant physiology, does the fact that growing,

senescing, galled and mosaic-diseased leaves all have something in common for the aphids.

My thanks are due to Dr. K. M. Smith for carrying out the virus inoculations.

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A New Type of Pathogenic *Mycobacterium*

In 1948 skin lesions due to a new acid-fast organism, *Mycobacterium ulcerans*, were reported from Australia[1]. The lesions were swarming with bacilli; but no growth was obtained on media incubated at 37° C. Culture at 33° C. gave growth.

Some seventy cases of a rather chronic, papulous, cutaneous disease producing ulcerations, which may be due to another acid-fast organism likewise not growing at 37° but at 31° C., have been observed in the past few years at Örebro, Sweden. The lesions were usually localized to the elbows. Some of the patients reported that they had scratched the elbow in a swimming pool two to three weeks earlier. The disease always healed within six months to two years, even when left untreated.

We examined histologically the lesions from thirty patients with this disease. Tuberculoid granulation tissue was almost always found. In one case a few acid-fast organisms were observed inside the lesion. Lesions from twenty patients were examined bacteriologically. In three cases acid-fast organisms growing at 31° C. were isolated. Large yellowish-white colonies appeared on Lœwenstein medium. The colonies were flat with a central nipple. The growth obtained when the glycerine concentration was 0·5–10·0 per cent was good, but when glycerine was omitted from the medium it was poor. Incubation at 31° C. gave growth after 8–10 days; at 22° C. growth usually required three weeks. Culture at 37° C., even with prolonged incubation, gave no growth. The bacilli were Gram-positive and strongly acid-fast. They were not sensitive to *para*-aminosalicyclic acid in experiments kindly carried out by Prof. J. Lehmann (Gothenburg).

Material was then collected from the swimming pool and examined. Organisms with the same characteristics as the bacilli isolated from the three human cases were found in scrapings from the cemented wall of the pool and in samples of the water.

The pathogenic properties of the acid-fast bacilli isolated were studied experimentally in animals. The organisms were found to be only slightly pathogenic for guinea pigs; large intraperitoneal injections occasionally gave localized abscesses in the scrotum. Papulous lesions showing the same microscopic changes as the human lesions were reproduced in the skin of rabbits by infecting ulcerations, produced by rubbing the shaved skin with sandpaper, with a suspension of organisms. Following intraperitoneal, and sometimes also intravenous, injections of bacilli into male rabbits, granulomatous inflammation with caseous necrosis was found in the scrotum. The lesions contained a few acid-fast organisms.

Most white mice infected intraperitoneally became seriously ill and died. Abscesses and ulcerations appeared on the tail, the paws and the scrotum. Widespread lesions were frequently found in the internal organs, especially in the lungs, which showed numerous caseous patches. The lesions produced in the mice contained enormous masses of acid-fast bacilli. Amyloidosis of the liver, spleen and kidneys was frequently observed. After several months of illness a few of the mice seemed to show signs of recovery.

Rats infected intraperitoneally showed no signs of disease; but on microscopic examination numerous tuberculoid structures were found in the omentum and sometimes in the hilar lymph nodes. The lesions contained many acid-fast bacilli. Intravenous or intraperitoneal injection of the bacilli into chickens produced no lesions. The effect of such injections on other animals is being studied.

Guinea pigs and rabbits infected by intraperitoneal injection were tested intradermally with tuberculin (Tuberculin P.P.D. kindly supplied by Dr. K. Tolderlund, of the State Serum Institute, Copenhagen). No reactions to a dose of 5,000 tuberculin units were observed in guinea pigs followed up for three months. Some rabbits gave definite reactions to a dose of 500 tuberculin units six to seven weeks after the injection of the bacilli.

A suspension of autoclaved bacilli was injected intradermally into three tuberculin-positive human volunteers. After forty-eight hours, there appeared skin reactions similar to those obtainable with tuberculin. Later, these lesions became necrotic. Microscopic examination showed the presence of tuberculoid granulations.

Judging by the behaviour of the bacillus, it seems to be a hitherto undescribed type of pathogenic *Mycobacterium*. It is probably not identical with *Mycobacterium ulcerans*. Dr. G. Buckle (Australia) was kind enough to place at our disposal cultures of *Mycobacterium ulcerans*. The bacteria under discussion were found to differ from the Australian bacilli as regards both growth on artificial media and their effect on experimental animals.

Cases of tuberculoid skin granuloma caused by atypical acid-fast bacilli have been reported from Sweden[2,3]. The histological picture resembled that of the lesions seen in our patients. In the less advanced cases, however, numerous rather thick, acid-fast bacilli were seen in the lesions. Culture at 37°, 31° and 24° C. showed no growth[4]. This may therefore be a disease differing from the one observed by us. Tuberculoid skin-granuloma after swimming-pool accidents have been reported elsewhere[5,6], and it is possible that further investigations will show that such skin lesions are also due to acid-fast organisms similar to those described above.

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Surgically induced Splenogenic Anæmia in the Rabbit

THAT alterations in the functional interrelationships of the liver and spleen may cause changes in the formed elements of the blood is suggested by the syndrome of portal vein hypertension. In this connexion, the experimental work of Bock and Frenzel[1] is noteworthy. These workers reported that ligation of the splenic and gastric coronary veins leads to anæmia and leukopænia in the rabbit.

The present study, involving about thirty rabbits, is an examination of the pathogenesis of this anæmia. In a group of eight rabbits, a mean fall of 26 per cent in the red cell count was observed following the ligation of the splenic and gastric coronary veins. Similar changes in hæmoglobin and hæmatocrit were observed. This anæmia is well established by the fourth or fifth day after operation and persists for four to six weeks, after which the red blood cell count returns to normal. Leukopænia, as reported by Bock and Frenzel[1], was not seen in the present work. Splenectomy, as is to be expected from other reports[2], induced no such anæmia.

Our experimental evidence indicates that: (1) the spleen can elaborate an anæmia-producing factor; (2) this factor is normally inactivated by passage through the portal venous system; and (3) when the splenic venous blood is diverted directly into the caval system by-passing the liver, anæmia results.

That splenic congestion plays no significant part in the anæmia is indicated by several findings: (*a*) the anæmia never reaches maximal intensity before the fourth day, by which time the collateral circulation is well established; (*b*) gross increase in spleen size is never noted beyond the first few hours after ligation; and (*c*) ligation of the splenic and gastric coronary veins after intravenous injection of red cells labelled with phosphorus-32 shows that less than 4 per cent of the circulating red cells are in the spleen eighteen hours after ligation.

Devitalization of splenic tissue by congestive ischæmia (in the first few hours after operation) and absorption of such necrotic tissue apparently play no significant part. Free introduction of the completely extirpated spleen into the peritoneal cavity causes no anæmia, although the spleen is completely absorbed; moreover, absorption of devitalized spleen would not be expected to continue for the six-week duration of the anæmia.

There remains the possibility that the spleen can elaborate a factor which is capable of producing anæmia when introduced into the general circulation without first passing through the portal system. Data which are compatible with this concept include: (*a*) splenectomy at the height of the anæmia leads to prompt return to normal of the red cell count; (*b*) intramuscular injections of pestle-homogenized whole normal spleen induce comparable anæmia in the splenectomized animal (this has not yet been tried with the intact animal); (*c*) *in vitro* incubations of red cells of normal and vein-ligated animals in the plasma of the vein-ligated animal cause significant hæmolysis; (*d*) upon recovery of the animal from the induced anæmia, injection of the portal system with liquid latex shows newly formed and opened channels which convey significant amounts of splenic venous blood to the portal system. After recovery from the anæmia, the red cell count can again be depressed by ligation of the short gastric vessels.

This splenogenic anæmia was further characterized by studies of hæmoglobin metabolism using alpha-carbon-14-acetate as hæmoglobin precursor.

The carbon-14 activity of the circulating-erythrocyte-hæmoglobin in the vein-ligated animal does not exhibit the normally observed plateau of about sixty days[3] after the injection of the labelled precursor. Rather, it shows a random decay curve indicative of a hæmolytic type of anæmia[4]. The estimated life-span of the red cell in the vein-ligated animal is of the order of 15–25 days, as contrasted with the normal life-span of 65–70 days.

This paper is based on work performed under contract with the United States Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, New York.

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Psychological and Biochemical Effects of Lysergic Acid Diethylamide

Stoll[1] and Condrau[2] have shown that the psychological effects of lysergic acid diethylamide (*LSD*—25), an amide of one of the constituents of ergot, are similar to those obtained in mescaline intoxication, but are produced by the oral administration of quantities as small as 0·02–0·06 mgm. While, in our experiments, the symptoms varied greatly from one person to another, the basic pattern of reaction seemed the same in twenty subjects who were members of the hospital staff. After initial slight autonomic symptoms, such as enlarged pupils, feeling of cold, 'goose flesh' and mild nausea, the most marked changes were emotional, a pleasurable feeling tone amounting to euphoria and bursts of laughter; this sometimes alternated with, or later was followed by, depression. There was also a general complaint of a feeling of lassitude and muscular weakness. In spite of some difficulty in concentrating, consciousness remained clear and introspection almost undisturbed. Visual illusions and hallucinations, especially illusions of movement, colour and distortions of the body image were frequently present.

The minute dosage required to produce the psychological effect of lysergic acid diethylamide suggested that its mode of action was due to an anti-enzyme action. Since, normally, the only substrate metabolized by the brain cell is glucose, an investigation of the effect of the drug on carbohydrate metabolism *in vivo* was attempted.

Blood samples were taken from the fasting subjects and at intervals of one and two hours after the administration of the drug, the following analyses being made by the methods indicated: glucose[3], hexosemonophosphate[4], lactic acid[5], alkali reserve[6], pyruvic acid[7], inorganic phosphate, total acid-soluble phosphate, lipoid phosphate and adenosine triphosphate[8]. On a subsequent day, identical control

analyses were made on most of the subjects, but with the substitution of a placebo for the drug.

No significant variations in the result of the two sets of analyses were found, except in the cases of glucose and hexosemonophosphate. For the latter the mean level of the experimental analyses rose by 1·65 mgm./100 ml. one hour after taking the drug and fell by 0·9 mgm./100 ml. during the subsequent hour. The corresponding figures for the control analyses were falls of 2·3 and 2·4 mgm./100 ml. respectively. In the case of blood glucose the experimental results showed a mean rise of 15 mgm./100 ml. after one hour and 11 mgm./100 ml. after two hours. The control analyses showed a mean fall of 1 mgm./100 ml. after one hour and a mean rise of 1 mgm./100 ml. after two hours.

The subjects were fasting and at rest throughout both the experimental and control periods. In these circumstances the only available source of carbohydrate would be glycogen, the first step in the metabolism of which is the formation of hexosemonophosphate. Under conditions of complete rest the rate of glycogen metabolism might be expected to fall, and this was reflected by a fall in the blood concentration of hexosemonophosphate in the control analyses. The increases in hexosemonophosphate and glucose in the experimental observations suggest that there is an increased metabolism of glycogen coupled with a probable block in the breakdown of hexosemonophosphate. If the increase of hexosemonophosphate should be due to increased demand for carbohydrate by the central nervous system, one would expect increases also in lactate, pyruvate, etc., together with a decrease in glucose. The fact that, on the contrary, no such changes occurred and the glucose is raised, suggests that the raised level of hexosemonophosphate is caused by a break of the cycle at this point.

A certain hypobulia and absorption in the passive state of feeling made the relation in time of biochemical to psychological change somewhat imprecise. However, symptoms of the vegetative system and of emotional nature appeared during the first hour and before the more specific symptoms such as illusions, hallucinations and other disorders of the perceptive field, which were of longer duration.

It is suggested that the changes in carbohydrate metabolism observed after the intake of lysergic acid diethylamide are responsible for at least part of the psychological symptoms. The alternative view that the alterations in carbohydrate metabolism are a parallel effect of the drug unconnected with its psychological effect seems improbable. Further studies which are now in progress should elucidate this point.

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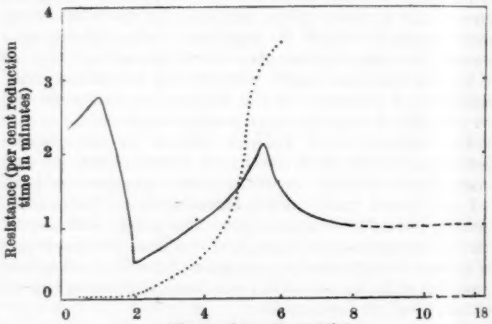
Variation with Age in the Resistance of Bacterial Cells

In an article in *Nature* of April 28, p. 666, Sir Cyril Hinshelwood discusses some of the possible explanations for deviations from the logarithmic order of death sometimes shown among bacteria exposed to disinfecting agents. Where the final stages of decline are abnormally protracted (that is, where there is a resistant 'tail' of organisms), he suggests that the most obvious explanation would be the presence of some cells of abnormally high resistance, and that these might originate from the interruption of growth at the appropriate stage in the cell-cycle. He considers it possible that at certain phases in the growth of each individual cell there might be a stage of maximum resistance, possibly when the internal condition of the vegetative cell bears the maximum resemblance to a spore.

The work of Ellicker and Frazier[1] with *Bacterium coli* cultures exposed to heat at various ages lends support to this view. These workers found that, after falling to a minimum during the period of most active reproduction, the resistance of their organism reached a high level as the culture entered the stationary-growth phase.

Recent work carried out in this laboratory on the thermal resistance of some strains of *Streptococcus fæcalis* has yielded very similar results, and it is hoped to publish these in more detail elsewhere. It was found that after exhibiting very high resistance during the lag phase of growth, the young cultures then experienced a period of minimum resistance which later gave place to a second peak as the rapid growth phase neared its end. Later still, the resistance fell to a level characteristic of mature cultures (see graph).



Variation with age in the thermal resistance of one strain of *Str. fæcalis*. Resistance—at 60° C.—is expressed as a percentage reduction time, and the growth curve is obtained by direct microscopic counts of one loopful of incubating culture

The time taken for the full growth/resistance cycle to be accomplished varied with different strains of the same organism; but the general shape of the curve remained the same. Change in incubation temperature did not affect the general character of the age/resistance relationship; but, apart from the obvious effect on the time taken to pass through each stage (varying with the growth-rate), it did influence the degree of resistance attained at any one stage.

The death-rate of young cultures in the logarithmic growth-phase, plotted as the logarithm of the number of surviving cells against time, was characteristic and was rarely in the form of a straight line. Many of the graphs were curves showing a preliminary 'rush'

in death-rate, probably due to the large proportion of cells in the most susceptible stage of their cycle (that is, those actively engaged in multiplication). A resistant 'tail' of cells dying more slowly was most distinct in these cases—these were probably the older, more mature cells, which must gradually accumulate in number as reproduction slows down, thus causing the high resistance typical of cultures nearing the maximum growth stage.

The death-rate of young cultures still in the lag-phase of growth and also of the older ones nearing the stationary phase approached more nearly a logarithmic straight line, in the same way as those of mature cultures.

From this experimental work, it was concluded that one of the possible causes of any variations in resistance among cells in mature cultures might be the slight variations in true (physiological) ages of the cells comprising such cultures. The cells in a 24-hr. culture would be mostly very similar in age; but if some growth were proceeding, however slowly, this might be just sufficient to produce variations in resistance, quite apart from any gradations found in a homogeneous culture. This conclusion is somewhat similar to those drawn by Sir Cyril Hinshelwood.

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[1] *J. Bact.*, **36**, 83 (1938).

Active Relaxation of Unstriated Muscle produced by Adrenaline

ADRENALINE is one of the most powerful inhibitors of tone in unstriated muscle; it is therefore expected to produce active relaxation. Active relaxation by adrenaline has been found in pieces of circular muscle of frog's stomach[1,2] and in guinea pig's uterus[3]. The movements of unstriated muscle, compared with those of striated muscle, are very sluggish, so that complicated apparatus is not necessary to follow contraction and relaxation. These experiments with adrenaline and frog's stomach muscle are most satisfactory, as there is no preliminary contraction except that of the normal tone, and the muscle just lengthens.

Transverse and longitudinal pieces from the stomach muscle of the frog *Rana tigrina* were used[4]. The length of the unloaded muscle was measured in saline of *p*H 8 before and 20 min. after adding adrenaline chloride. The experiments were performed at 25–27·5° C., this being the optimum temperature for active relaxation. On addition of adrenaline, circular muscle of frog's stomach begins to lengthen almost immediately up to a maximum of 40 per cent of its initial length, the lengthening being almost complete in about ten minutes. The muscle relaxed actively in all concentrations of adrenaline tested, the experimental range being 1 in 10 million to 1 in 40,000, and the maximum relaxation occurring in 1 in a million upwards. Compared with circular fibres, longitudinal fibres lengthened very little. Thus in twenty experiments, ten showed no change in length, while the rest lengthened by 4–9 per cent. The reaction of the longitudinal fibres was examined to exclude lengthening of circular fibres by their contraction if there were any such effect. Near the cardio-œsophageal sphincter, the longitudinal fibres relax more (5–25 per cent in eight experiments), so that here both sets of fibres relax actively. Circular muscle from the cardiac half of the stomach also is more sensitive than that from the pyloric half, in which active relaxation may not occur owing to the presence of alactic tone[5].

Active relaxation in frog's stomach muscle undergoes seasonal variations; it is best observed when the room temperature is 25–30° C. During the winter months, it diminishes or is absent, even if the temperature of the saline is raised to 25–30°. The optimum *p*H is 8; but if the tone is great, increase in acidity to *p*H 6·5 may indirectly improve the response by diminishing tone[1]. Substances that increase tone, such as replacement of the chloride of the saline with bromide, iodide, thiocyanate, or excess of potassium ions, antagonize active relaxation. Cyanide abolishes active relaxation, which is restored by glucose.

The virgin guinea pig's uterus or a small portion of uterus in early pregnancy has been used to demonstrate active relaxation produced by adrenaline. The guinea pig is killed by a blow on the head, the uterus is removed and the uterine horns are immersed in saline of *p*H 8 at 25–30° C.[6,7]. The horns are then split longitudinally and if pregnant the contents are removed. The muscles begin to relax actively immediately on addition of adrenaline. The maximum relaxation, up to about 60 per cent of its initial length, is produced by small concentrations (1 in 10 to 1 in 5 million). It becomes less with larger concentrations[5], owing to the tendency to contraction with such doses. It is well known that small concentrations of adrenaline produce inhibition although large doses produce contraction. With large doses, after 10 min. the muscle begins to contract, and as tone thereafter increases, active relaxation becomes less or disappears if the experiment is repeated every 30 min. With small concentrations, the experiment can be repeated, as there is no tendency to contraction or such increase of tone. The elongation is not due to contraction of the circular fibres, as there is no eversion of the split longitudinal edges; moreover, substances that cause contraction do not produce any elongation. Active relaxation may be produced by concentrations of adrenaline as low as 1 in 1,000 million. The optimum temperature is 25–30° C. At 37° C., active relaxation is feeble and, if tone increases, it is absent. Substances that increase tone, such as lithium, ammonium, potassium, excess of calcium, strontium, barium, bromide, iodide, nitrate or thiocyanate ions, diminish or abolish active relaxation. Cyanide abolishes active relaxation, which may partially be restored by glucose. Longitudinal muscle of rabbit's gut, though very sensitive to adrenaline as regards passive relaxation, does not relax actively. Therefore the tonus of unstriated muscle can be of three kinds, when active or passive relaxation by adrenaline is considered: (1) the muscle does not relax actively or passively; (2) the muscle relaxes actively as well as passively; (3) the muscle relaxes passively but not actively.

Active relaxation due to the action of adrenaline on the contractile mechanism should be tested on a background of mild contraction, such as produced by *p*H 6·5 (phosphate)[8]; there are individual and seasonal variations, some muscles not contracting in phosphate. Similarly, the action of acetylcholine on the contractile mechanism should be tested on a background of relaxation, such as is produced by potassium[9].

A convincing example of active relaxation has been found to occur in the retractors of the introvert of the marine worm *Golfingia* (*Phascolopsis*) *gouldii* (Pourtales). The retractors are removed along with the

brain and immersed unloaded in sea water in a Petri dish. The brain is stimulated by slight pressure with a forceps. The muscles contract and relax actively again. In more than 20 muscles, the relaxation was from 100 to 200 per cent of their length during the contracted state. If sodium cyanide (1 in 10,000) is added to the sea water, the muscles contract, but do not relax actively. Microscopic examination shows that the muscle consists of longitudinal bundles of fibres[10].

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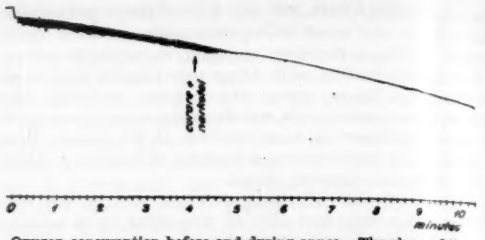
Diffusion Respiration in Man

Draper and Whitehead and their co-workers[1] have described a phenomenon which they have called 'diffusion respiration'. In experiments with dogs, they have shown that the blood under certain conditions will be normally oxygenated from the lungs without respiratory movements and without rhythmical changes of pressure in the lungs. They explain this phenomenon as follows. Owing to the affinity of oxygen for hæmoglobin, the amount of oxygen removed from the alveoli during apnea exceeds the amount of carbon dioxide that simultaneously enters from the blood. The pressure within the alveoli is therefore reduced below that of the atmosphere, and a continuous inward movement of the dead-space air and the external atmosphere takes place. Essential conditions, however, for diffusion respiration are a high percentage of oxygen in the lungs and in the dead space, a free airway and an adequate circulation. During the first thirty minutes of diffusion respiration the uptake of oxygen is not reduced. After this time the oxygen consumption and the oxygen content of the blood decrease due, probably, to the Bohr effect produced by retention of carbon dioxide, with respiratory acidosis and low blood *p*H.

Investigations of the phenomenon of diffusion respiration in man have not so far been reported. Some practical observations, however, particularly from work on anæsthetics, afford ground for believing that, under the above-mentioned conditions, in man also enough oxygen can be absorbed in the lungs without respiratory movements. We have therefore studied this question.

Method. During intravenous anæsthesia with 'Narkotal' (a short-acting barbiturate), an air-tight tracheal tube with inflatable cuff was passed. After 10 min. inhalation of 100 per cent oxygen from an anæsthetic machine, the tracheal tube was connected with the expiratory hose of a Krogh's spirometer containing pure oxygen. The absence of measurable positive pressure in the spirometer was thoroughly controlled. The respiratory movements and the oxygen uptake were recorded during about five minutes. After that the subjects were given curare and 'narkotal' in adequate doses for apnea. The



Oxygen consumption before and during apnea. The slope of the curve indicates the oxygen consumption (about 0·2 lit./min.), which thus seems independent of respiratory movements

periods of apnea were interrupted by re-connecting the tracheal tube to the anæsthetic machine and starting artificial respiration by rhythmic manual compressions of the re-breathing bag. Immediately before, at the end of, and 5 min. after each period of apnea, samples were taken from arterial blood and from lung air (7–11 cm. below the tracheal bifurcation) for analysis of the oxygen and carbon dioxide content. Pulse-rate, blood pressure and electrocardiogram were recorded during the experiments.

Results. The subjects were kept in apnea for about five minutes, the maximum being 7 min. 20 sec. The oxygen consumption during this time was, as a rule, the same as during the period before the apnea. The oxygen content of the blood did not decrease during the apnea. The carbon dioxide content of the blood and of the lung air, on the other hand, increased during the apnea, but after five minutes of artificial respiration with the aid of the anæsthetic machine the values of the carbon dioxide were normal again. No changes of importance were noticed concerning pulse-rate, blood pressure and electrocardiogram. The subjects remained all the time in a very good condition.

Conclusion. The phenomenon of diffusion respiration, which Draper and Whitehead and their co-workers have demonstrated in animals, seems to occur also in man. Accordingly, it is possible to get sufficient oxygen uptake during short periods of time without either spontaneous or artificial respiratory movements and without rhythmic changes of pressure in the lungs, if the circulation is adequate, and if pure oxygen is supplied through a free air-passage. The accumulation of carbon dioxide prevents prolongation of the apnea for a considerable time.

A complete report of these investigations will be published elsewhere.

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Fluorometric Determination of Natural Œstrogens in Urine; Elimination of Fluorogenic Compounds

The fluorometric analysis of œstrogens in urine using phosphoric acid for the development of the fluorescence has already been described[1,2]. A difficulty was observed in applying this method to urines in which the œstrogen titre was low, for example, to non-pregnancy urines, since the values obtained with the fluorometric method for normal male and female urines were higher than those yielded by the bioassay (Allen–Doisy test). In addition, a 'quench-

ing' effect has been observed. These findings suggested that another substance or substances were augmenting the fluorescence produced by the œstrogens. The 'non-specific fluorescence' has also been observed by Engel[3,4], who prepared his urinary extracts by the countercurrent partition method.

Another difficulty lay in the comparatively low recoveries of the œstriol added to urine[2].

It was therefore desirable to revise the partition procedure in order so far as possible to eliminate the 'non-specific fluorescence', and also to improve the recovery of the added œstrogen.

Substitution of ether for benzene in the initial extraction of the œstrogens from the urine led to improved recovery of œstriol. This step merely constituted a return to the original method of B. Zondek[5], who used ether for extracting the œstrogenic substances from urine. Recently, Engel also recommended the use of ether instead of benzene[3,4]. On extraction of the ether solution with *N* sodium hydroxide, the œstrogens (œstradiol, œstrone and œstriol) passed almost quantitatively into the alkaline phase, after which adjustment to a *p*H of *c.* 8 was again extracted with ether and then evaporated to dryness. For the partition of the three urinary œstrogens into œstrone–œstradiol and œstriol fractions, many pairs of solvents were tried. The most suitable partition was obtained between benzene/petroleum ether (1 : 1) and water, in which œstradiol and œstrone remained in the organic phase, whereas œstriol passed into the water. From this point the two fractions were treated separately.

The benzene / petroleum ether (œstrone–œstradiol fraction) was evaporated to dryness, the residue was taken up in ether, which was evaporated after washing with 30 per cent sulphuric acid, saturated sodium bicarbonate and water. The residue was dissolved in an accurately measured amount of ethanol, from which aliquots were taken for fluorometry.

The œstriol fraction was treated as follows. The aqueous layer, adjusted to *p*H 8 (according to Engel[3,4] much less fluorogenic material is extracted at this *p*H), was extracted with ether. The ether solution was washed with saturated sodium bicarbonate and water, and evaporated. The residue was dissolved in 50 per cent methanol, which was washed with carbon tetrachloride and evaporated to dryness. The residue was redissolved in an accurately measured quantity of ethanol, and aliquots of this solution were used for fluorometry.

The development of the fluorescence was essentially the same as that described previously[1,2]. The readings of the fluorescence in the present study were carried out with the aid of a Farrand fluorometer instead of the Coleman fluorometer previously employed. The primary light was filtered with a Farrand interference filter with the transmission at 440 mμ. The secondary filter (to the photomultiplier) was a Farrand interference filter with the transmission at 530 mμ. For eliminating any non-specific fluorescence the readings were repeated using a Corning 5860 filter which passes the 365 mμ mercury line instead of the 440 mμ filter. Subtracting the second reading from the first yielded linear responses for œstradiol, œstrone and œstriol in pure solutions, and it can be used to advantage in urinary extracts. Recoveries obtained using this method have been of the order of 85 ± 15 per cent. The non-specific fluorescence was greatly reduced, and as little as 20 γ œstrone and about 30 γ œstriol per litre could thus be determined.

A detailed account will be published elsewhere.

I am grateful to Prof. Bernhard Zondek for his interest in, and support of, this investigation. I am also much indebted to Miss L. Berlin, Mr. A. Schwager and Mrs. L. Beyth for their valuable assistance. The investigation has been aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

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Determination and Occurrence of Fluorescent Substances in the Neutral Fraction of Urinary Extracts

IT has been shown that the natural phenolic œstrogens produce fluorescence on being heated with phosphoric acid[1,2]. When applying this method to urinary extracts, it was found that a non-specific fluorescence obscures the readings for the œstrogens, especially in the 'strong phenolic fraction'—the œstriol fraction. On attempting to purify the œstrogenic fractions of the non-specific fluorescence, we observed that a great part of it was non-phenolic, but was due to a 'neutral' substance or substances, which were carried over in the partition procedure then used (a modified Bachmann–Pettit method[2]) to the œstrogenic fraction.

A new procedure was therefore elaborated for the œstrogens (see the preceding communication) and the neutral fraction was studied concurrently. Briefly, the procedure for the preparation of the neutral fraction was as follows. The hydrolysed urine was extracted with ether, and after washing with *N* sodium hydroxide, saturated sodium bicarbonate and water, it was evaporated to dryness. The residue was dissolved in a small amount of ethanol. Benzene/petroleum ether (1 : 1) was added and the mixture was transferred to a separating funnel. It was vigorously extracted with distilled water, and the aqueous phase was in turn extracted with ether, which after washing with saturated sodium bicarbonate and water was evaporated. The residue was dissolved in 50 per cent methanol, which was then washed with carbon tetrachloride. The methanol was distilled off *in vacuo*, and the residue redissolved in ethanol, from which samples were taken for the development of the fluorescence with phosphoric acid in the usual manner[1,2]. For determination of the fluorescence a Farrand fluorometer was used, and the technique was similar to that described in the preceding communication.

Details about the fluorescent substance or substances in the neutral fraction will be reported elsewhere.

Here we would like to mention that these substances seem to be of biological importance if judged by the fact that they have been found in small amounts in every human urine examined. Their excretion seems to be somewhat increased at the time of ovulation; a considerably increased excretion

has been found so far (*a*) in cases with adrenogenital syndrome (pseudo-hermaphroditism), (*b*) in arrhenoblastoma, (*c*) in the last months of pregnancy. Excretion increased following injection of 300 mgm. of adrenotropic hormone over a period of three days.

The chemical constitution of the fluorescent substance or substances of the neutral fraction—probably of adrenal cortical origin—are being studied in collaboration with Prof. T. Reichstein of Basle.

We are much indebted to Miss L. Berlin, Mr. A. Schwager and Mrs. L. Beyth for their assistance. This investigation has been aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

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[1] Finkelstein, M., Hestrin, S., and Koch, W., *Proc. Soc. Exp. Biol. and Med.*, **64**, 64 (1947).
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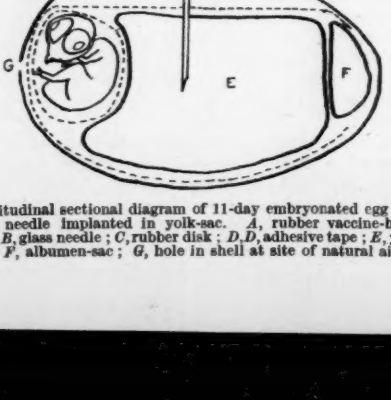
A Method for Administering Chemotherapeutic Agents to Chick Embryos

The technique described was developed for the purpose of studying the action of chemotherapeutic agents, given in divided doses by the yolk-sac route, on the proliferation of vaccinia virus in embryonated eggs.

A glass needle is prepared by drawing out a piece of tubing of approximately 6 mm. internal diameter to a capillary 4·0–4·5 cm. long. The wide end of the tube is cut off 1·0 cm. from the point of narrowing, and the capillary end is bevelled to a sharp point on the flat surface of a rotating 'Carborundum' dental disk. (It is advisable to wear an eye-shield during this operation.) The wide end of the needle is closed with a small rubber vaccine-bottle cap. A number of these assemblies are prepared and autoclaved.

11-Day embryonated eggs are candled, and a point marked in the centre of the long axis where the chorio-allantois is well developed, but as far from the embryo as possible. A triangle of shell is cut away from this point, the shell membrane is pierced, and the chorio-allantoic membrane is 'dropped' by suction through a hole drilled into the natural air-sac. The yolk-sac can then be seen lying directly beneath the opening.



Longitudinal sectional diagram of 11-day embryonated egg with glass needle implanted in yolk-sac. *A*, rubber vaccine-bottle cap; *B*, glass needle; *C*, rubber disk; *D,D*, adhesive tape; *E*, yolk-sac; *F*, albumen-sac; *G*, hole in shell at site of natural air-sac

The glass needle, which has been forced for about 3 cm. of its length through the centre of a sterile rubber disk of the type used in 1-oz. 'Universal Container' caps (2·75 cm. in diameter), is next inserted through the chorio-allantoic membrane, and into the yolk-sac, until the rubber disk rests upon the shell, to which it is then secured with strips of adhesive tape (see diagram). One worker, with an assistant to drill the eggs, can set up thirty to forty such preparations within an hour.

The chorio-allantois can be infected with the test virus before insertion of the glass needle, or afterwards by injection with a fine hypodermic needle through the rubber disk.

Injections of the chemotherapeutic agent can now be made at desired intervals through the vaccine cap with a hypodermic syringe. The small quantity of fluid remaining in the glass needle after injection is expelled into the yolk-sac by the further injection of a small quantity of air. Up to 1·0 ml. of fluid may be thus administered in divided doses.

At the end of the experiment, the glass needle is withdrawn, the rubber disk removed, and the egg opened for examination. The interference with the chorio-allantois is minimal. A small hole surrounded by a very small area of tissue reaction will be seen where the needle has passed through. The embryos tolerate this procedure remarkably well; in our hands deaths attributable to inoculation trauma have amounted to less than 5 per cent of the total treated, in experiments lasting 48–72 hr.

The advantages claimed for this method are: (*a*) the chemotherapeutic agent is not given by the same route as the virus, thus obviating any direct virucidal action; (*b*) repeated injections may be given under completely sterile conditions, maintaining a high concentration of test agent in the tissues; (*c*) the injections are placed in the yolk-sac with absolute precision, especially in older embryos in which the usual injection route via the air-sac is not always satisfactory; (*d*) repeated doses may be given to large numbers of embryos with rapidity.

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Isolation of 2 : 3 : 4 : 6-Tetramethylpyridine from Coal Tar

During an investigation, previously referred to[1], of the nitrogenous bases extracted by sulphuric acid from the 'benzol absorbing oil' fraction of vertical retort coal tar, a tertiary base has been isolated which has been proved to be 2 : 3 : 4 : 6-tetramethylpyridine, a compound which has not hitherto been reported as a constituent of coal tar. This compound, however, has been previously isolated from Fushun shale oil by Eguchi[2], and from Scottish shale oil by Benzie and Milne[3].

The base was isolated from a fraction (boiling point 135–135·2° C./100 mm.) obtained by high-efficiency fractional distillation (efficiency approximately 100 theoretical plates) as follows. The fraction was treated with the theoretical amount of picric acid in three equal portions, the picric acid being added as a saturated alcoholic solution. In this way three batches of picrate were obtained, the first two of which melted at 110–120° C. and con-

sisted of fine needles. The third batch of picrate melted at 150–170° C.

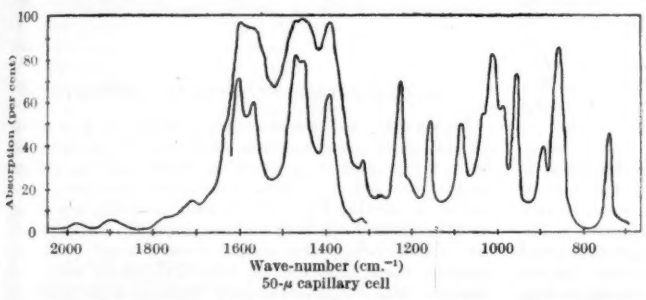
The first two fractions of picrate were combined and recrystallized repeatedly from 95 per cent alcohol until a constant melting point of 122–123° C. was attained. This material was then recrystallized twice from acetone, thereby raising the melting point to 122·5–123° C. This melting point agrees very well with the value of 122·5–123·5° C. given by Benzie and Milne for 2 : 3 : 4 : 6-tetramethylpyridine picrate, and a mixed melting point determination showed no lowering.

The free base was regenerated from this pure picrate by treatment with caustic soda and steam distillation. It was then dried and redistilled. The pure base was found to be a colourless liquid with quite a pleasant smell and the following physical characteristics.

b.p. 203° C./750 mm.	Lit. 203·3° C./760 mm.	(ref. 2)
n_D^{25} 1·5087	Lit. 1·5084	(ref. 2)
D_4^{25} 0·9322	Lit. 0·9345	(ref. 3)

From this pure product, the picrolonate (m.p. 225·5° C., decomp.) and the methiodide (m.p. 192–193° C.) were prepared. The value found for the picrolonate was identical with that given by Benzie and Milne, and a mixed melting point determination showed no lowering.

The infra-red absorption spectrogram of the base, which was recorded by Mr. J. L. Hales of the Department of Scientific and Industrial Research, was found to be identical with that for the compound obtained by Benzie and Milne and to follow the graph reproduced herewith.



The above evidence of infra-red absorption spectrograms, physical properties, melting points and mixed melting points, is sufficient to prove that this base, isolated from coal tar, is 2 : 3 : 4 : 6-tetramethylpyridine.

The isolation of this compound leaves only two of the nineteen possible methyl homologues of pyridine still unidentified in coal tar. These are 3 : 4 : 5-trimethylpyridine and pentamethyl pyridine, neither of which has been reported as being isolated from any natural source, nor has either been prepared.

A complete account of this work will be published at a later date.

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Paper Chromatography of Flax Fibre Polyuronide Hemicellulose

It is well known that pectic substances are broken down during the retting of flax. There is evidence that other polyuronides also occur in flax straw and are attacked in retting[1]. Their constitution is therefore of great interest in flax research. The sugar constituents of the polyuronide hemicellulose have been investigated. This substance was obtained from fibre separated from flax straw by purely mechanical means without previous retting. Finely ground fibre was extracted successively with ether, petroleum ether, ethanol and water. Pectic substances were removed with seven 30-min. extractions with boiling 0·5 per cent ammonium oxalate solution. The residue, after washing with water, ethanol and ether followed by air-drying, was extracted twice for 24 hr. with cold 4 per cent sodium hydroxide solution. The filtered extract was acidified with glacial acetic acid and the hemicellulose was precipitated with ethanol. The precipitate was well washed and dried from ethanol and ether. Approximately 3 gm. of polyuronide hemicellulose was obtained as a slightly greyish powder, lignin content 1·8 per cent, uronic acid anhydride content 7·1 per cent (19 per cent hydrochloric acid method[2]).

The hemicellulose was hydrolysed with *N* sulphuric acid at 100° C. for six hours. After cooling, solid barium carbonate was added until the liquor was no longer acid to congo red paper. The clear liquor obtained after centrifuging was evaporated on a hot water-bath and the residue dissolved in pyridine[3]. Mineral matter was separated by centrifuging, the solution was allowed to evaporate in a stream of air and a thin syrup was prepared for paper chromatography.

The procedure of Jermyn and Isherwood[4] was followed and the following solvent mixtures were used : (*a*) butanol – ethanol – water (4 : 1 : 5)[5] and (*b*) (4 : 1·1 : 1·9)[6] parts by volume ; (*c*) butanol – acetic acid – water (2 : 1 : 1)[6] and (*d*) ethyl acetate – acetic acid – water (3 : 1 : 3)[4]. Known sugar solutions (1 per cent w/v) were run simultaneously on the filter paper with the hemicellulose hydrolysate for identification purposes. The positions of the sugars were revealed by brushing with aniline hydrogen phthalate[7] or *p*-anisidine hydrochloride[6]. Solvents (*a*) and (*b*) did not separate arabinose and mannose, but (*c*) and (*d*) showed the presence of both in the hydrolysate. All four solvents showed the presence of galactose, glucose, xylose and rhamnose. No ketoses were detected. In addition to these six sugars, when a more concentrated syrup was used, two faint spots were observed of R_D values (distance moved relative to rhamnose or *iso*-dulcite)[8] in solvent (*c*) 0·84 and 0·92 respectively.

Flax fibre polyuronide hemicellulose therefore contains arabinose, xylose, galactose, glucose, mannose and rhamnose, together with a uronic acid constituent, the nature of which is under investigation, and traces of two other substances. The flax plant is seen to contain a variety of polyuronides, namely, pectic substances, hemicellulose, seed mucilage and probably polyuronides of a gummy nature. An intensive study of this one species may therefore throw some light on the origin of these carbohydrates.

This communication is published by permission of the Home Flax Production Department, Board of Trade.

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Quantitative Chromatographic Separation and Estimation of Cadmium in Copper Alloys using Paper Strips

Bishop and Liebmann[1] have described the quantitative separation of zinc from soldering alloys by chromatography on cellulos columns followed by polarographic estimation. We employ a similar method for the determination of small amounts of cadmium in copper–cadmium alloys, except that we use paper strips of normal thickness.

Our procedure is briefly as follows. A solution of a weighed amount of the alloy is prepared in the minimum volume of nitric acid diluted 1 to 3, and made up accurately in a volumetric flask to a cadmium concentration in the range 10^{-4} to 10^{-3} gm. per millilitre; 0·3 ml. of this solution is placed by means of an 'Agla' micrometer syringe (Burroughs Wellcome, Ltd.), 5 cm. from one end of a 4 cm. × 45 cm. strip of Whatman No. 1 paper. Spreading of the band of solution may be lessened by applying the solution in 0·1 ml. or smaller portions and allowing each to dry before applying the next. The chromatogram is developed by a method very similar to that described by Linstead *et al.*[2], but using methyl ethyl ketone plus 30 per cent by volume of A.R. hydrochloric acid as the developing solution. After about sixteen hours the chromatogram is allowed to dry in air. The copper band, which is yellowish-green in colour, begins about 20 cm. from the starting position; the cadmium band commences within a few millimetres of the front of the copper band and extends for 2–4 cm. It is usually accompanied by a brown to pink coloration apparently derived from the developing solution; a freshly mixed solution gives less of this coloration than an old one. No interference with the separation has been observed, but the front of the copper band is more easily visible when the coloration is absent.

The whole of the lower portion of the strip containing the cadmium is extracted and washed with boiling 1 per cent hydrochloric acid. The filtrate and washings are combined and evaporated gently to dryness. The residue is treated with about 0·5 ml. of 60 per cent perchloric acid and again evaporated to dryness to destroy traces of organic matter which have been found to interfere sometimes with the polarographic wave-form. The residue is then dissolved in exactly 2 ml. of 0·5 *M* potassium chloride solution in 1 per cent hydrochloric acid and a portion polarographed in a 2-ml. cell after passing hydrogen for five minutes. As an internal standard, 0·002 ml. of a standard solution of cadmium metal in A.R. hydrochloric acid is then introduced directly into the polarographic cell with the 'Agla' syringe.

For alloys containing 0·2–1·3 per cent cadmium, the coefficient of variation of our results has been found to be of the order of 1 per cent, which compares very favourably with the spectrographic solution–spark method, which we have found to give a coefficient of variation of about 3 per cent. The method is less time-consuming and much more convenient than the usual macro-chemical methods, and it is suggested that it could be readily adapted for other analyses.

It is hoped to describe the method in greater detail elsewhere.

A large part of the credit for this work must be accorded to Miss J. Houghton, who has carried out the practical work, and without whose patience and practical suggestions its completion would have been long delayed. Thanks are due to Dr. L. G. Brazier, director of research and engineering, British Insulated Callender's Cables, Ltd., for permission to publish this communication.

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Carbohydrate Primers for Q-Enzyme

For some time we have been engaged in a study of the starch-synthesizing enzymes of *Polytomella cæca*, a flagellate which produces starch from sodium acetate and ethyl alcohol, but not from sugars[1]. This starch is similar to most natural starches inasmuch as it consists of amylose and amylopectin components, the latter being the major constituent[2]. It has already been reported by Lwoff, Ionesco and Gutmann[1,3] that *Polytomella cæca* contains a phosphorylase which utilizes glucose-1-phosphate as the substrate for the synthesis of an iodophilic polysaccharide; this claim has been verified in these laboratories[4]. However, since phosphorylases are known to catalyse the formation of only 1 : 4-α-glycosidic linkages, it seemed probable that, for the synthesis of the branch points of amylopectin, the organism must employ a second enzyme, similar to the *Q*-enzyme of the potato[5] or the 'branching factor' of liver and heart[6].

This second enzyme has now been isolated[4] by a method which was essentially that used by Barker, Bourne and Peat[7] in the case of potato *Q*-enzyme. The protozoal enzyme converts amylose into a polysaccharide, which is stained red with iodine and has been proved to belong to the amylopectin–glycogen class[4].

The purpose of the present communication is to record certain phenomena encountered during the early stages of the reaction catalysed by the *Q*-enzyme of *Polytomella cæca*; these phenomena have not been described in reports of the properties of *Q*-enzyme samples derived from other sources. When dilute solutions of the protozoal enzyme were incubated with amylose samples containing different degrees of

amylopectin impurity, the rates of reaction, as measured by the changes in the iodine-staining powers of the digests, were markedly different; in general, the higher the blue value[8] of the amylose the slower was the reaction-rate. Indeed, with amyloses having the highest blue value there was an appreciable time-lag in the initiation of the reaction and, thereafter, the rate of reaction increased progressively. The lag phase was reduced considerably and the subsequent reaction-rate increased by the introduction of potato amylopectin, the native amylopectin of *Polytomella cæca*, glycogen, dextrins, or commercial maltose, whereas inulin, xylan, dextran, cellobiose, lactose, sucrose, glucose, galactose or fructose did not show this effect. Thus it would seem that, for the display of optimum activity, samples of the *Q*-enzyme of *Polytomella cæca* require the presence of a carbohydrate primer containing glucose units mutually linked by 1 : 4-bonds in the α-configuration. The autocatalytic reaction observed with the purest amyloses in the absence of added primer may be attributed to the ability of the products of the reaction to function as primers.

That the observed effects were not due to the activation of possible traces of amylase impurities in the enzyme samples was shown by the fact that the small reducing powers developed during the course of the enzyme action were not influenced by the presence or absence of primer. Pending further work on this problem, we tentatively suggest that it is the *Q*-enzyme itself which requires the carbohydrate primer. If this be true, then the phenomenon is analogous to that obtaining in the phosphorylase-catalysed synthesis of linear chains, for it is already generally agreed that a 1 : 4-α-linked glucose polymer is required to initiate the synthesis of amylose from glucose-1-phosphate[9].

We are indebted to Prof. M. Stacey for his interest in this work, and to the Royal Society and the Department of Scientific and Industrial Research for grants to two of us (S. A. B. and A. B.).

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Pregnan-7-ol and Pregnan-12-ol

Ruff and Reichstein[1] have described a pregnan-7-ol and a pregnan-12-ol prepared by Wolff–Kishner reduction of acetoxypregnane ketones. They state that these two substances are probably the 7α- and 12α-hydroxy compounds; but since epimerization during Wolff–Kishner reduction is not excluded, they name them provisionally '7ξ' and '12ξ'[2]. The molecular rotations of pregnan-7ξ-ol and of pregnan-12ξ-ol and their derivatives show that the two new compounds are indeed 7α and 12α.

Barton and Klyne[3] have summarized the molecular rotation contributions of a large number of substituents in the steroids. The terms ΔO and ΔA have been used for the contributions of hydroxyl and acetoxyl groups, and Δ_1 (Barton[4]) for the molecular rotation difference on acetylation ($\Delta A - \Delta O$). The ΔO, ΔA and Δ_1 values for pregnan-7ξ-ol and -12ξ-ol are compared with the standard values in the accompanying table.

Molecular rotation difference	Compound	Δ Values for ξ compounds[1]	Standard Δ values[3] α	β
ΔO	Pregnan-7-ol	− 54	− 79	+95
ΔO	,, -12-ol	+ 43	+ 93	+50
ΔA	,, -12-ol acetate	+205	+280	+76
Δ_1	,, ,,	+162	+187	+26

The ΔO value for pregnan-7ξ-ol shows that it must have the 7α configuration. While no conclusions can be drawn from the ΔO value of pregnan-12ξ-ol, the ΔA and Δ_1 values for its acetate prove clearly that it must have the 12α configuration.

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Use of Nuclear Research Emulsions for Fast-Neutron Dosimetry

The use of nuclear research emulsion for the measurement of fast neutron doses has been described by Titterton[1]. The purpose of this communication is to describe an extension of this technique to the measurement of energy absorption in hydrogenous material irradiated by fast neutrons.

A unit of biological significance in irradiation of living material is the energy absorption of the material from primary or secondary ionizing particles. It has been shown theoretically by Mitchell[2] that in tissue irradiated by fast neutrons of energies between 0·5 and 5 MeV., 90 per cent of the energy deposition is due to elastically scattered protons. Such recoil protons may be observed and their ranges measured in nuclear research emulsions exposed to fast neutrons. On the assumption that the ratio of the energy deposition per unit volume of emulsion and tissue is equal to the ratio of the atomic density of hydrogen in the two materials, the energy deposition in tissue can thus be determined.

Ilford *C*.2 plates of 400 microns nominal thickness were exposed to a beam of D + D neutrons from the electrostatic generator at the Radiotherapeutic Research Unit, Hammersmith; the maximum spectral energy of the neutrons was 5 MeV. The energy deposition in a volume of emulsion defined by a rectangular parallelepiped was determined by measurement of the ranges of all proton tracks observed in

the volume, using the range–energy relation for that emulsion[3] for determination of the corresponding energies. Boundary effects were taken into account by scanning a volume of emulsion which was surrounded in every direction by a thickness of emulsion greater than the maximum proton range. This was effected by scanning between two planes parallel to the free surface of the emulsion at 100 microns distance from the top and lower surfaces of the emulsion respectively.

Tracks totally enclosed in the parallelepiped were measured, also the partial lengths within the scanned volume of those tracks which crossed the horizontal boundaries. To enable the energy dissipation of a proton which starts in the scanned volume and proceeds out of it to be determined, it is necessary to measure both the full and enclosed length of its track. The energy dissipation in the enclosed portion of the track is then obtained by subtracting the energy dissipation in the residual portion of the track from that of the whole track.

Since in this energy region the neutron–proton scattering is isotropic in centre-of-gravity co-ordinates, recoil protons of all energies from zero to the incident neutron energy are emitted with equal probability. Tracks produced by low-energy protons are difficult to detect and measure, more especially if they have a large angle of dip. The energy deposition by protons of energy less than an arbitrary value E_1 may, however, be applied as a correction to the total energy deposition measured. The value of this correction factor is small, and for mono-energetic neutrons of energy E_0 is $E_0^2/(E_0^2 - E_1^2)$. For C 2 emulsion and a minimum track-length of four microns, corresponding to $E_1 = 0{\cdot}40$ MeV., the correction is less than 5 per cent when E_0 is greater than 2 MeV.

The correction for a complex neutron spectrum can be calculated if the energy distribution of the neutrons is known.

In a typical plate, the scanning of 250 fields of view gave 851 complete tracks of energy greater than 0·4 MeV., and 41 partial tracks in a volume corresponding to 0·493 mm.^{3} of unprocessed emulsion. The total energy dissipation in this volume was found to be $1{\cdot}37 \times 10^3$ MeV. The energy spectrum of the neutrons was determined from an Ilford C.2 plate of 200 microns thickness which was simultaneously exposed in the same position as the 400-micron plate, the analysis being made by the standard method of measurement of the ranges of forward-scattered protons[4]. From this spectrum the correction factor for protons of energy less than 0·40 MeV. was found to be 4 per cent. Hence the total energy dissipation is found to be 4·60 ergs per c.c. of emulsion. Assuming the tissue to have unit density and 11 per cent hydrogen content by weight, and the C.2 emulsion to have a normal hydrogen content of 0·056 gm./c.c.[1], the equivalent tissue dose is calculated to be 9·04 ergs/gm. or 0·11 rep.

Experiments indicate the suitability of this method for determination of the energy deposition due to a fast-neutron dose up to 0·2 rep.; larger doses lead to an inconveniently high track density for microscopic observation. Further experiments are in progress, in conjunction with Dr. L. H. Gray, to compare the results obtained by this method and the ionization chamber[5].

I am indebted to the Medical Research Council for permission to expose plates at the Radiotherapeutic Research Unit, Hammersmith, the British Empire Cancer Campaign for the award of a research fellowship, and Prof. J. Rotblat for his interest and encouragement throughout the work.

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A New Calculation of the Cohesive Energy of Metallic Beryllium

Following the success of the Wigner–Seitz cellular method[1] for the calculation of binding energies of the alkali metals, a treatment for divalent metals was given by Herring and Hill[2], who carried out detailed calculations for beryllium, taking into account the effect of the Brillouin zone boundaries. Recently, a simpler method has been used by Raimes[3] for magnesium, and reasonable agreement with experiment was obtained. This communication presents the results of a new calculation for beryllium, similar to that of Raimes, undertaken with the object of ascertaining whether a simpler treatment could be applied to beryllium, and whether Raimes's suggestion regarding the correlation energy in the free atom would be satisfactory in this case.

Wave functions corresponding to the lowest state of an electron in the lattice have been obtained by numerical integration for eight values of the radius r_s of the atomic sphere. The field acting on a given electron was taken to be that of the ion-core[4] plus that due to all the electrons with opposite spin. The eigenvalue of the Schrödinger equation was found by approximating successively until the boundary condition was satisfied at $r = r_s$ (gradient of wave function equal to zero). The Fermi energy was obtained in the form α multiplied by free electron value, and the effective mass parameter α was determined by Bardeen's method[5]. Values of α were obtained by numerical integration for all eight values of r_s; at the experimental radius $r_s = 2{\cdot}37$ Bohr units, the value $\alpha = 0{\cdot}616$ was obtained, in exact agreement with Herring and Hill, but the present calculation gives somewhat higher values for larger values of r_s. The free electron expressions for the exchange and correlation energies have been used, as in Raimes's paper. Exchange interaction between valence and core electrons was neglected in the metal and in the free atom; moreover, interaction between the ion-cores was assumed to be negligible.

For the free atom the energy of the valence electrons was taken from the Hartree approximation[4]; in the treatment of Herring and Hill the experimental value was used, which resulted in a low value for the cohesive energy. The correlation energy was derived according to Raimes's suggestion of a proportion of the total energy of the valence electrons or of the Coulomb interaction energy. For beryllium both methods give the same result, namely, $-0{\cdot}013$ Rydbergs/electron.

Finally, the work function was evaluated according to the method described by Herring and Nichols[6], using the calculated total energy ($-1{\cdot}086$ Rydbergs/electron) at the calculated lattice constant ($r_s = 2{\cdot}34$

	Present calculation	Herring and Hill	Experimental
Lattice constant (Bohr units)	2·34	2·23 to 2·57	2·37
Cohesive energy (kcal./mole)	84	53	75
Compressibility (cm.²/kgm. × 10¹²)	8·0	7·5 to 11·3	7·8
Work function (volts)	−0·3	−1·9	3·9

Bohr units). The complete results are shown in the table and, with the exception of the work function, show very satisfactory agreement with experiment.

The experimental compressibility is taken from Bridgman[7] and refers to 30° C.; the calculated values refer to absolute zero.

A detailed account of these calculations will be published elsewhere.

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Mechanical Properties and Structure of Sol-type and Gel-type Gelatine Films

Films can be prepared from aqueous sols of gelatine either by evaporating off the water slowly at room temperature, when gel formation precedes dehydration, or directly from the sol by maintaining the drying temperature at a sufficiently high level (for example, 60° C.), which defers the development of structure until the drying process is nearing completion. Pinoir and Pouradier[1] showed that thin sol-type films produced in this way were soluble in water at room temperature, whereas the gel-type films merely swelled under the same conditions. They pointed out the significance of their observation in view of the earlier discovery of Katz and his colleagues that gelatine film prepared at room temperature gave a crystalline X-ray powder diagram, whereas that given by the film prepared hot was of the more amorphous type. They inferred that the difference in solubility between the two was caused by the more extensive organization and bonding of chains in the gel type.

We have produced gel-type and sol-type films by regulating the temperature of drying as described above, and have made an X-ray examination of their structure. In general conformity with Katz's findings, the results suggest the presence of small randomly arranged crystallites in the sol-type film, and of much larger crystallites in the gel type. The crystallites in the gel type tend to lie in the plane of the film, but are randomly arranged within this plane. This orientation in a direction parallel to the plane of the film has been found in films made from other substances in which development of a network structure precedes drying out. The orientation is no doubt caused by the uni-directional collapse of the network as the film contracts on drying in a direction perpendicular to the supporting base.

When immersed in boiling methanol, the gel-type film contracted very considerably in length and width and increased in thickness; the sol-type film softened with the same treatment but its dimensions did not change. This thermal contraction of the gel-type film indicates that the chains in the original film were in the (at least) partially extended condition in the plane of the film, and the lack of it in the sol type that the chains were fully, or almost fully, contracted in this film. It seems likely, therefore, that, starting with a state of contracted chains in the sol, straightening of the chain results as a necessary consequence of its association into an ordered crystalline structure, and the degree of straightening should depend on the length of the crystallite. In the preparation of the sol-type film, the rapidity with which the structure is developed in the crowded system of contracted chains favours the development of many small crystallites, while the more leisurely development of structure in the more widely spaced chain system in the gel and in the subsequent slow drying is consistent with the presence of much more extensive crystallites in the gel-type film.

The tensile properties of the two types of film have been measured after conditioning in atmospheres of relative humidity ranging from 45 to 85 per cent, and the results of these tests (see table) are consistent with the structural picture outlined above.

Temperature of Preparation of Film and the Ambient Humidity during Testing: Effects on Tensile Properties

Temp. of preparation of film (° C.)	Relat. hum. during testing (per cent)	Tensile properties: Tensile strength (kgm./sq. cm.) Mean	S.D.	Extension at break (per cent) Mean	S.D.
20°	45	910	48	1·9	0·2
60°	45	654	31	1·1	0·1
20°	55	832	52	2·2	0·3
60°	55	585	33	1·5	0·1
20°	65	646	59	3·7	0·7
60°	65	350	22	1·7	0·2
20°	75	418	29	10·2	1·7
60°	75	172	36	46·1	5·6
20°	85	170	38	23·8	3·6
60°	85	81	11	129	20

S.D. = standard deviation.

As would be expected, the structure containing the larger crystallites (gel type) is always stronger than that in which the inter-chain bonding is less extensive. For both types of film the tensile strength falls, and the extension at break increases, with increasing ambient relative humidity, and is a consequence of the progressive weakening of the inter- and intra-chain bonds by the increasing amount of water absorbed. Up to 65 per cent relative humidity, the extension is small and is probably mainly due to a partial failure of these bonds since, although small, it does increase appreciably with the relative humidity. At relative humidities of 75 and 85 per cent, the extension at break is much greater than before, and is much greater in the sol type than in the gel type. It is evident that failure of the inter- and intra-chain bonding is much more nearly complete at these humidities, so that the chains themselves are able to extend. When this occurs, the contracted chains in the sol-type film are able to allow a much greater extension than the comparatively extended chains in the gel type. Even after extending to the point of breakage, the films recover their original length (to within 5 per cent) on relaxing the stress, and it seems likely that the elastic behaviour could be largely accounted for in terms of the entropy change on extension.

We hope to publish these results in more detail elsewhere at a later date.

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Magnetic Properties, Internal Strains, and the Bauschinger Effect in Metals

Wilson[1] has recently reported that the intensity of magnetization of a high-carbon steel increases with plastic deformation of one kind, but that it suffers a recession after a relatively small additional plastic strain applied in a direction opposite to that originally used. I suggest that these results could be predicted from an analysis of the Bauschinger effect.

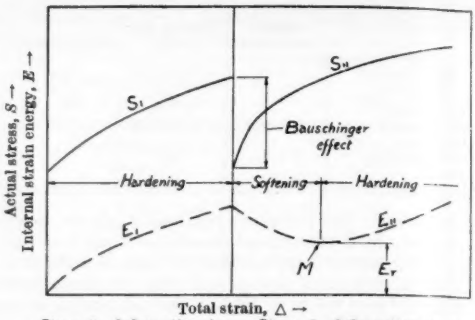
The conventional explanation of this effect[2] accounts for the abrupt fall of resistance to deformation when the direction of the external stress is reversed (see diagram, *S*-curves). It is easy to see, however, that the simultaneous decrease of internal strain energy E of the cold-worked metal can be only gradual, and that E must reach a minimum M before starting to rise again. Since work-hardening is never fully reversible, some residual strain energy E_r remains latent in the metal.

This analysis implies that all energy-dependent properties affected in one manner during unidirectional deformation must be affected in the opposite manner on subsequent reversed straining. In fact, tensile elongation, recrystallization temperature, and sharpness of X-ray diffraction rings and spots, do behave in the way expected[3], and in a detailed report[4] it will be shown that the Bauschinger effect is also accompanied by appreciable mechanical softening. The maximum decrease of Vickers hardness was 3–10 points in steels with 0·07–0·14 per cent carbon, and up to 26 points in medium- and high-carbon steels with 0·45–1·15 per cent carbon. Equivalent results were obtained with non-ferrous metals, and the amount of softening was consistent with the magnitude of the Bauschinger effect in each case.

Upon these findings, a general rule was formulated stating that work softening occurs whenever the method of cold working used tends to produce an internal stress system different from that left after the preceding treatment, irrespective of whether the latter was of mechanical or of thermal nature. Since the building-up of a new system of internal stresses must be preceded by a partial destruction of that existing previously, there is a transient decrease of E, demonstrated by softening.

The above rule immediately explains why the hardness of sorbitic and troostitic steels either remains constant[5,6] or even falls substantially[4,7] during the early stages of cold working. The same apparently applies to magnetic properties[1], and probably to density as well. Obviously, if 'back straining' is continued, the intensity of magnetization will also ultimately increase, but only after passing through a minimum, just like E in the right-hand side of the diagram.

It seems, therefore, that Brinell or Vickers hardness tests provide a more convenient and sound basis for investigating internal stresses in metals than magnetic tests. Not only are they less cumbersome, but also they are more sensitive, since for reversed deformations varying from 4 to 8 per cent no difference whatever in intensity values was detected (ref. 1, curve 3). Furthermore, hardness tests are equally applicable to steels and non-ferrous metals, and are also sensitive to directional variations of properties. Finally, although the relations between hardness and stress values are not always clear, they are certainly simpler than those between magnetic properties and mechanical stresses.



Diagrammatic representation of changes of resistance to deformation S, and of internal strain energy E, associated with the Bauschinger effect. It is assumed that for $\Delta = 0$, also $E = 0$

N. H. Polakowski

Metallurgical Department,
University College, Swansea. June 12.

[1] Wilson, D. V., *Nature*, **167**, 899 (1951).
[2] Barrett, C. S., "Structure of Metals", 329 (McGraw-Hill, New York, 1943).
[3] Burgers, W. G., "Handbuch der Metallphysik", **3**, Pt. 2, 492 (review) (Akad. Verl. Becker and Erler, Leipzig, 1941).
[4] Polakowski, N. H., *J. Iron and Steel Inst.* (to be published).
[5] Andrew, J. H., and others, *J. Iron and Steel Inst.*, **165**, 145 (1950).
[6] O'Neill, H., *Proc. Inst. Mech. Eng.*, **151**, 166 (1944).
[7] Armour, J. D., *Trans. Amer. Soc. Steel Treat.*, **17**, 521 (1930).

Large Prime Numbers

For about seventy-five years the largest known prime number has been $P = 2^{127} - 1$, identified as such by Edouard Lucas. It has remained the largest known in spite of many attempts to identify larger ones, although there have been conjectures and claims insufficiently substantiated or entirely unproved.

Recently we have prepared a routine for testing on the Edsac the primality of numbers of the form $kP + 1$, with P as defined above, and have found ten values of k that give prime numbers. The largest of these gives the present (June 7) largest known prime, namely,

$$934(2^{127} - 1) + 1.$$

J. C. P. Miller
D. J. Wheeler

June 7.

Note added in proof (*October* 8). Further work on the Edsac by Wheeler and myself has demonstrated the primality of

$$978(2^{127} - 1) + 1$$

and culminated in early July in the identification of the present largest known prime,

$$180(2^{127} - 1)^2 + 1.$$

Also, in early July, A. Ferrier, of France, using a desk machine, demonstrated the primality of

$$(2^{148} + 1)/17,$$

which is the second largest known prime.

J. C. P. Miller

University Mathematical Laboratory,
Cambridge.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, November 12

UNIVERSITY OF LONDON (at the London School of Economics and Political Science, Houghton Street, Aldwych, London, W.C.2), at 5 p.m.—Prof. P. Gourou: "La Géographie du Monde Tropical".* (Further Lectures on November 13 and 15.)

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE, PHILOSOPHY OF SCIENCE GROUP (in the Council Room, University College, Gower Street, London, W.C.1), at 5.30 p.m.—Prof. W. I. B. Beveridge: "What is Wrong with the] Philosophers' Accounts of Scientific Method ?"

INSTITUTION OF ELECTRICAL ENGINEERS, EDUCATION DISCUSSION CIRCLE (at Savoy Place, Victoria Embankment, London, W.C.2), at 6.0 p.m.—Discussion on "The Equipment of an Electrical Engineering Laboratory" (to be opened by Mr. A. Draper and Mr. T. Siklos).

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 6 p.m.—Dr. M. V. Wilkes: "Automatic Calculating Machines" (Cantor Lectures). (Further Lectures on November 19 and 26.)

Tuesday, November 13

ZOOLOGICAL SOCIETY OF LONDON (at the Zoological Gardens, Regent's Park, London, N.W.8), at 5 p.m.—Scientific Papers.

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 6 p.m.—Mr. H. F. Stephenson: "The Equipment and Functions of an Illumination Laboratory".

SHEFFIELD METALLURGICAL ASSOCIATION (at the Grand Hotel, Sheffield), at 7 p.m.—Dr. K. W. Andrews: "Some Simple Theoretical Aspects of Ferrous Metallurgy".

Wednesday, November 14

INSTITUTE OF PETROLEUM (at Manson House, 26 Portland Place, London, W.1), at 5.30 p.m.—Dr. S. F. Birch: "Detergents from Petroleum".*

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. G. H. Metson, Dr. S. Wagener, Mr. M. F. Holmes and Mr. M. R. Child: "The Life of Oxide Cathodes in Modern Receiving Valves".

PHYSICAL SOCIETY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 5.30 p.m.—Dr. A. B. Wood: "Underwater Acoustics" (Duddell Medal Address); Dr. J. H. E. Griffiths: "Ferromagnetic Resonance" (Charles Vernon Boys Prize Address).

UNIVERSITY OF LONDON (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.30 p.m.—Dr. D. D. Woods: "The Scientific Basis of Medicine, 11, Folic Acid and Vitamin B_{12} in the Metabolism of Micro-organisms".* (Further Lectures on November 16, 20, 23, 27 and 29, December 4, 6 and 11.)

ROYAL SOCIETY OF ARTS (joint meeting with the BRITISH HOROLOGICAL INSTITUTE, at John Adam Street, Adelphi, London, W.C.2), at 6 p.m.—Mr. H. Alan Lloyd: "George Graham and his Clocks".

ROYAL STATISTICAL SOCIETY, STUDY SECTION (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 6 p.m.—Mr. A. Anson and Mr. T. Cauter: "Market Research".

TEXTILE INSTITUTE, MACCLESFIELD, LEEK AND DISTRICT SECTION (at Wm. Frost and Sons, Ltd., Elizabeth Street Canteen, Macclesfield), at 8 p.m.—Dr. B. P. Ridge: "The New Textiles".

Thursday, November 15

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Special General Meeting to consider the Annual Report of Council; Scientific Papers.

INSTITUTION OF MINING AND METALLURGY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. E. K. McDermott: "Major Changes in Mining Practice during Ten Years 1940–1950, Rhokana Corporation, Ltd.".

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. M. H. A. Newman, F.R.S.: "Coincidence and Fixed-Point Theorems" (Presidential Address).

UNIVERSITY OF LONDON (at King's College of Household and Social Science, Campden Hill Road, London, W.8), at 5.30 p.m.—Miss L. E. Charlesworth: "The United Nations and Technical Assistance".*

WOOL EDUCATION SOCIETY (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 7.15 p.m.—Prof. W. T. Astbury, F.R.S.: "How the Wool Molecule Works, and its Further Significance in Biology and Medicine".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Scientific Papers.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 7.30 p.m.—Laboratory Meeting.

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall, 32 Welbeck Street, London, W.1), at 8 p.m.—Prof. J. E. Roberts: "Is Your Physics Really Necessary ?" (Presidential Address).

Friday, November 16

ROYAL SOCIETY OF MEDICINE, EPIDEMIOLOGY AND STATE MEDICINE SECTION (at 1 Wimpole Street, London, W.1), at 4.30 p.m.—Discussion on "Undergraduate Teaching of Social and Preventive Medicine".

ROYAL GEOGRAPHICAL SOCIETY (at 1 Kensington Gore, London, S.W.7), at 5 p.m.—Lieut. L. R. R. Foster: "Navigational Work with the Polar Ship *Norsel*".

ROYAL INSTITUTE OF PHILOSOPHY (at University Hall, 14 Gordon Square, London, W.C.1), at 5.15 p.m.—Rev. Dr. A. M. Farrer: "Religion".* (Further Lecture on November 23.)

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. H. Roxbee Cox: "Some Fuel and Power Projects" (Thomas Hawksley Lecture).

UNIVERSITY OF LONDON (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.30 p.m.—Prof. F. G. Young, F.R.S.: "The Scientific Basis of Medicine, 12, Adrenal Hormones and ACTH".* (Further Lectures on November 20, 23, 27 and 29, December 4, 6 and 11.)

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, POLAROGRAPHIC DISCUSSION PANEL of the PHYSICAL METHODS GROUP (at the Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1), at 6 p.m.—Annual General Meeting; Scientific Papers.

WOLVERHAMPTON SOCIETY OF APPLIED SCIENCE (at the Chamber of Commerce, New Street, Birmingham), at 6.30 p.m.—Dr. A. E. Werner: "Scientific Examination of Paintings".

INSTITUTE OF PHYSICS, MANCHESTER AND DISTRICT BRANCH (in the New Physics Theatre, The University, Manchester), at 7 p.m.—Mr. W. J. Meredith: "Recent Advances in the Applications of Physics to Medicine" (Chairman's Address).

SOCIETY OF CHEMICAL INDUSTRY, FINE CHEMICALS GROUP (at the Middlesex Hospital Medical School, London, W.1), at 7 p.m.—Dr. C. R. Ricketts and Dr. K. W. Walton: "Blood Anticoagulants with Special Reference to Dextran Sulphate".

ROYAL INSTITUTION (at 21 Albermarle Street, London, W.1), at 9 p.m.—Dr. T. E. Allibone, F.R.S.: "New Materials in Engineering".

Saturday, November 17

BRITISH PSYCHOLOGICAL SOCIETY, SOCIAL PSYCHOLOGY SECTION (in the Anatomy Theatre, University College, Gower Street, London, W.C.1), at 2.30 p.m.—Prof. R. W. Russell: "Psychological Research in American South-west Indian Cultures".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT ANALYST IN THE DEPARTMENT OF THE PUBLIC ANALYST—The Registrar and Secretary, The University, Bristol (November 17).

ASSISTANT LECTURER IN APPLIED MATHEMATICS—The Clerk, Birkbeck College, Malet Street, London, W.C.1 (November 17).

HEAD OF THE CHEMISTRY DEPARTMENT, Rutherford College of Technology—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne 1 (November 17).

HEAD (Grade II) OF THE ENGINEERING DEPARTMENT, Chance Technical College—The Chief Education Officer, 215 High Street, Smethwick 41 (November 17).

LECTURER IN AGRICULTURAL ENGINEERING AND BUILDING CONSTRUCTION at Gwebi Agricultural College—The Secretary, Southern Rhodesia Government, 429 Strand, London, W.C.2 (November 24).

CHIEF ELECTRICAL ENGINEER, an ELECTRICAL ENGINEER, a WATER SUPPLY ENGINEER, and an INDUSTRIAL CHEMIST, in the Development Board of the Government of Iraq—J. D. Atkinson, c/o Coode, Vaughan-Lee, Frank and Gwyther, 9 Victoria Street, London, S.W.1 (November 26).

SENIOR LECTURER IN MECHANICAL ENGINEERING—The Principal, Heriot-Watt College, Edinburgh (November 26).

WEED ECOLOGIST—The Secretary, National Vegetable Research Station, Wellesbourne, Warwick (November 26).

ASSISTANT LECTURER IN PATHOLOGY at the University of Queensland—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (November 30).

ASSISTANT STATISTICIANS in the Civil Service—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 96/51 (November 30).

CHAIR OF ELECTRICAL ENGINEERING in the New South Wales University of Technology, Sydney—The Agent-General for New South Wales, 56 Strand, London, W.C.2, or the Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (November 30).

LECTURER IN ENTOMOLOGY, and an ASSISTANT IN ZOOLOGY—The Secretary, The University, Edinburgh (November 30).

ASSISTANT AGRICULTURAL ECONOMISTS (two in the Ministry of Agriculture and Fisheries and one in the Department of Agriculture for Scotland)—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 4097/51 (December 6).

CHAIR OF PSYCHOLOGY at the University of Western Australia—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (December 7).

SENIOR PRINCIPAL PRODUCTION ENGINEER, Admiralty Production Pool—The Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting S.4098/51 (December 13).

SENIOR LECTURER and a LECTURER IN APPLIED MATHEMATICS, and a LECTURER IN PURE MATHEMATICS, at the University College of the Gold Coast—The Secretary, Inter-University Council for Higher Education in the Colonies, 1 Gordon Square, London, W.C.1 (December 15).

SENIOR LECTURER and a LECTURER IN THE DEPARTMENTS OF PURE AND APPLIED MATHEMATICS, University of Natal, Pietermaritzburg—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (December 15).

SENIOR LECTURERS and LECTURERS IN CROP PRODUCTION, ANIMAL PRODUCTION, AGRICULTURAL ECONOMY, AGRICULTURAL ENGINEERING, and SOIL SCIENCE, at the University College of the Gold Coast—The Secretary, Inter-University Council for Higher Education in the Colonies, 1 Gordon Square, London, W.C.1 (December 15).

CIVIL ENGINEERS, SANITARY ENGINEERS AND STRUCTURAL ENGINEERS, in a number of Departments in England and Scotland—The Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3405/A (December 31).

BACTERIOLOGIST at the Institute of Medical and Veterinary Science, South Australia—The Agent-General and Trade Commissioner for South Australia, Marble Arch, London, W.1 (Adelaide, January 2).

PROFESSOR OF PHILOSOPHY—The Registrar, University College, Singleton Park, Swansea (January 5).

AERONAUTICAL AND MECHANICAL ENGINEERS (Experimental Officer grade) mainly in the Aerodynamics and Structures Departments at the Royal Aircraft Establishment, South Farnborough—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting C.572/51A.

ASSISTANT BIOCHEMIST (university degree essential)—The Secretary, Preston and Chorley Hospital Management Committee, Royal Infirmary, Preston.

ASSISTANT EDUCATIONAL PSYCHOLOGIST (woman, honours or research degree in psychology and experience in teaching essential) to Child Guidance Clinic and Bristol Schools—Chief Education Officer, Council House, College Green, Bristol 1.

ASSISTANT (Grade B) IN THE MECHANICAL ENGINEERING DEPARTMENT—The Principal, Royal Technical College, Salford.

BANANA RESEARCH OFFICER (with a university degree in botany, preferably with chemistry, and capable of organizing the work of a small cold storage station), JAMAICA—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting 27059/260.

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT (Grade III), LECTURERS IN PHYSICS, CHEMISTRY, MECHANICAL ENGINEERING, MATHEMATICS (Engineering), PRODUCTION PLANNING, and ASSISTANTS IN BIOLOGY and allied subjects (Grade B), and ENGLISH USAGE for technical students (Grade A), Wolverhampton and Staffordshire Technical College—The Clerk to the Joint Education Committee, Education Offices, North Street, Wolverhampton.

HORTICULTURIST to take charge of glasshouse and small botanic garden and experimental plot—The Registrar, University College, Singleton Park, Swansea.

LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT—The Principal, Northampton Polytechnic, St. John Street, London, E.C.1.

METALLURGISTS to lead teams engaged on development work involving physical metallurgy, metallography, mechanical working, powder metallurgy, and melting and casting; METALLURGISTS to undertake development work in one of the fields mentioned above, involving large-scale plant in some cases; CHEMICAL ENGINEER to undertake large-scale development work on processes for the reduction and recovery of less common metals, at Springfields Factory, Salwick, Preston—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs.

PHYSICAL CHEMISTS (Scientific Officer grade) at Ministry of Supply experimental establishments mainly in the vicinity of Waltham Abbey, Sevenoaks and South-East London—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting F.603/51A.

PHYSICIST or MECHANICAL ENGINEER (honours degree in physics or mechanical engineering essential) for research on wire and bar drawing, at Sheffield—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, endorsed 'Wire Drawing'.

PHYSICISTS at the Ministry of Supply Radiochemical Centre, Amersham: PRINCIPAL SCIENTIFIC OFFICER/SENIOR SCIENTIFIC OFFICER (Ref. A.320/51A) to take charge of the Physics Department, and a SCIENTIFIC OFFICER (Ref. A.321/51A) for research and development work related to the production of radioactive isotopes, concerning particularly the absolute calibration of radioactive sources and health physics and associated problems in instrumentation—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, or Almack House, 26–28 King Street, London, S.W.1, quoting the appropriate Ref. No.

SCIENTIFIC OFFICERS at a Ministry of Supply Design Establishment in Surrey: PHYSICIST (Ref. A.308/51A) preferably with interest in statistics, to plan, supervise and report full-scale field trials which often involve optical and electrical instrumentation; PHYSICISTS (Ref. A.307/51A) for general physical investigations and for work connected with fire control equipment; MECHANICAL ENGINEER (Ref. C.644/51A) with aptitude for applied mathematics for work on vibration, stress and thermodynamics, or MECHANICAL ENGINEER preferably with electrical bias and workshop experience for general mechanical research and development; ELECTRICAL ENGINEERS (Ref. D.466/51A) for the application of electrical and electronic techniques to engineering problems—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting the appropriate Ref. No.

SENIOR ENGINEERS in the Ministry of Supply to encourage the adoption of improved production processes in the field of aircraft engineering—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting C.649/51A.

SENIOR METALLURGIST, to take general charge of research on bearing metals, bronze and other alloys containing tin—The Director, Tin Research Institute, Fraser Road, Perivale, Greenford, Middx.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council. Special Report Series No. 275: Studies of Undernutrition, Wuppertal 1946–9. By Members of the Department of Experimental Medicine, Cambridge, and associated Workers. Pp. xiv+404+62 plates. (London: H.M. Stationery Office, 1951.) 12*s.* 6*d.* net. [278

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 873, Vol. 243: Farey Section in $k(i)$ and $k(p)$. By J. W. S. Cassels, W. Ledermann and K. Mahler. Pp. 585–628. (London: Cambridge University Press, 1951.) 10*s.* [298

Fossil Mammals of Africa. No. 3: Associated Jaws and Limb Bones of *Limnopithecus macinnesi*. By W. E. Le Gros Clark and D. P. Thomas. Pp. 27+6 plates. (London: British Museum (Natural History), 1951.) 15*s.* [308

Department of Scientific and Industrial Research: Food Investigation. Special Report No. 54: The Condensation of Water on Refrigerated Surfaces. By J. K. Hardy, K. C. Hales and G. Mann. Pp. iv+34. (London: H.M. Stationery Office, 1951.) 1*s.* 6*d.* net. [308

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1949–1950. (Cmd. 8307.) Pp. 38. (London: H.M. Stationery Office, 1951.) 1*s.* 6*d.* net. [49

Record of the Science Research Scholars of the Royal Commission for the Exhibition of 1851. 1891–1950. Pp. iii+92. (London: Royal Commission for the Exhibition of 1851, 1951.) 7*s.* 6*d.* [49

Other Countries

The Malayan Grading Rules (Export) for Rough Sawn Timber. Pp. 43. (Kuala Lumpur: Department of Forestry, 1951.) 1 dollar; 2*s.* 6*d.* [208

Western Australia: Geological Survey. Bulletin No. 102: Greenbushes Mineral Field. By R. A. Hobson and R. S. Matheson. Pp. 219+9 plates. Bulletin No. 104: Some Economic Aspects of the Principal Tantalum-bearing Deposits of the Pilbara Goldfield, North-West Division. By H. A. Ellis. Pp. 93+9 plates. (Perth: Government Printer, 1949–1950.) [228

Commonwealth Scientific and Industrial Research Organization. Bulletin No. 250: Habitats and Community Relations of the Acrididæ of the Trangie District, N.S.W. By L. R. Clark. Pp. 20+3 plates. Bulletin No. 255: A Review of the Australian Mydaidæ (Diptera). By S. J. Paramonov. Pp. 32. (Melbourne: Commonwealth Scientific and Industrial Research Organization, 1949–1950.) [228

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 27, No. 6: Relationships of the Pelagic Shark *Euprotomicrus bispinatus*, with Description of a Specimen from off California. By Carl L. Hubbs and J. L. McHugh. Pp. 159–176. (San Francisco: California Academy of Sciences, 1951.) [228

Kungl. Skogshögskolans Skrifter. Nr. 5–6: Beräkning av Slutavverkningen; calcul de la possibilité, av Sven Petrini; Die Geschwindigkeit und der Verlauf des Transpirationsstromes bei der Birke, von Alno Mathiesen. Pp. 24. (Experimentalfältet: Skogsbiblioteket, Skogshögskolan, 1951.) [278

United Nations. Supplement (1951) to Catalogue of Economic and Social Projects 1950. Pp. xvi+310. (New York: United Nations; London: H.M. Stationery Office, 1951.) 2.50 dollars; 17*s.* 6*d.* [278

Geologisches Jahrbuch für das Jahr 1949. Herausgegeben von den Geologischen Landesanstalten der Bundesrepublik Deutschland. Band 65. Pp. lxxxii+790+7 plates. (Hannover: Amt für Bodenforschung, 1951.) 25 D. marks. [278

French Bibliographical Digest. No. 7: Science—Physics. Pp. iii+87. No. 8: Science—Chemistry. Pp. vii+72. (New York: French Embassy, 1951.) [298

Annals of the New York Academy of Sciences. Vol. 53, Art. 4: The Fundamental Aspects of Lubrication. By O. A. Beeck and 14 other Authors. Pp. 753–994. 4 dollars. Vol. 53, Art. 5: Specific Methods of Analysis. By Dr. S. E. Q. Ashley and 13 other Authors. Pp. 995–1118. 2.50 dollars. (New York: New York Academy of Sciences, 1951.) [49

Fieldiana. Anthropology, Vol. 36, No. 6: Acculturation and Material Culture, 1. By George I. Quimby and Alexander Spoehr. Pp. 107–148. (Chicago: Chicago Natural History Museum, 1951.) 1 dollar. [49

Annali della Facoltà di Scienze Agrarie della Università di Palermo. Vol. 1, Anno 1950. Pp. 370. (Palermo: Università, 1951.) [49

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1950. Pp. 16. (Zomba: Government Printer, 1951.) [49

Acustica: International Journal on Acoustics, sponsored by the Acoustics Group of the Physical Society of London. (6 numbers per annum.) Vol. 1, No. 1. Pp. 48. (Zürich: S. Hirzel, 1951.) Annual subscription, 36 Swiss francs. [49

Publications of the Dominion Observatory, Ottawa. Vol. 14: Bibliography of Seismology. No. 8: Items 7418–7570, July to December 1950. By W. G. Milne. Pp. 165–186. (Ottawa: King's Printer, 1951.) [49

State of Maryland: Board of Natural Resources, Department of Geology, Mines and Water Resources. Bulletin 9: Refractory Clays of the Maryland Coal Measures. By Karl M. Waagé. Pp. xvi+182. (Baltimore, Md.: Board of Natural Resources, 1950.) [49

Survey of India. General Report 1948–49, from 15th August 1947 to 31st March 1949. Pp. xi+82+7 plates+7 maps. 3 rupees; 5*s.* Technical Report 1948–49, from 15th August 1947 to 31st March 1949. Pp. iv+74+2 plates+2 maps. 3 rupees; 5*s.* (Dehra Dun: Survey of India, 1951.) [49

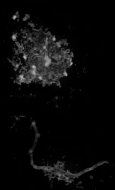
Rensselaer Polytechnic Institute Bulletin. Engineering and Science Series, No. 65: Azariah Thomas Lincoln, Scientist-Educator. By Dr. H. S. van Klooster. Pp. iii+8. (Troy, N.Y.: Rensselaer Polytechnic Institute, 1951.) [59

Catalogues

Catalogue of Books on Chemical Industry, including Metallurgy and Photography. Pp. 42. (London: H. K. Lewis and Co., Ltd., 1951.)

The Symbol of Power in Industry. 1: Machine Tool Drives. Pp. 8. (Manchester and London: Lancashire Dynamo and Crypto, 1951.)

Electronics for Industry. Pp. 8. (Rugeley: British Electronic Products, Ltd., 1951.)

Festival of Britain 1951. Pp. 6. (London: Crypto, Ltd., 1951.)

Doran Precision Electrical Measuring Instruments. Pp. 2. (Stroud Doran Instrument Co., Ltd., 1951.)